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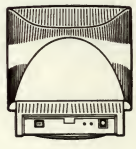

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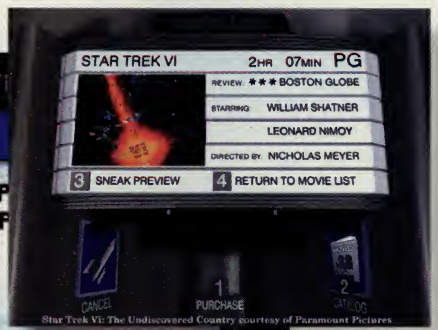
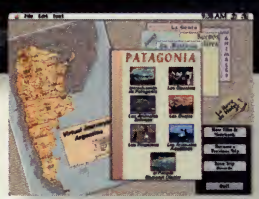


Logica Interactive Video Environment, *for video-on-demand, was authored in OMO. Courtesy of Paramount Pictures.*

With Personal News, *viewers can customize their own news service, and retrieve news from archives. It was developed in cooperation with CNBC, and authored in OMO.*

CD-Now *is a music catalog shopping application which allows users to preview, sample and purchase cassettes and CDs. It was authored in OMO.*



Virtual Journeys, *a language-learning program from Gessler Publishing Co., Inc. was authored in OMO.*

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VOLUME 2, NUMBER 5 MAY 1996

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FEATURES

HOW-TO COLUMNS

DEPARTMENTS

Cover photo: Paul Haggard. Images courtesy of Industrial Light & Magic

FROM THE EDITOR

WITCHCRAFT and other ESSENTIAL SKILLS

There was a time when those who attempted to divine the future bought themselves a quick ride in a Salem dunking stool. These days, such antics buy cars with names like Lexus and Mercedes and BMW for the guys practicing the arcane art of market analysis. Crystal balls and tea leaves have been replaced by NDAs, analyst briefings, and one-on-one interviews with captains of industry. Megabucks reports have taken the place of the astrological chart.

And while the forecasting methods are more scientific, the predictions don't necessarily carry any more certainty than a reading from the Psychic Friends Network.

Nevertheless, interactive media development, with its lengthy production cycles, is work that requires you to anticipate market conditions years in advance. Misjudge the expectations of your customers by failing to predict the technology *du jour* at your scheduled release date and, well, you can wave good-bye to that fancy car as the repo man hauls it away.

I mention all this because this issue of *InterActivity* offers some crystal ball gazing, genuine glimpses of the shape of things to come, and an unusually high concentration of hands-on evaluation of said things.

In the crystal ball department, contributing editor Omid Rahmat wades through facts, figures, and market share statistics related to all manner of delivery platforms from game consoles to PCs to the Internet. If his predictions don't surprise you, the numbers might. Check them out on page 39.

As for the shape of things to come, consider the numerous fronts on which incredible changes are taking place. First, SGI, Microsoft, Apple, and a lot of hardware vendors want to own the development platform market. That means they want your business. According to our own market surveys, roughly 50% of you professional developers are building titles on Mac and/or Windows/DOS machines, while 16% use SGI boxes. Microsoft launched its first salvo in the battle with an aggressive campaign that bundles Softimage 3D with a number of Windows NT workstations (see page 74 for details). SGI answered by announcing their Maximum Impact series with similarly amazing bundling deals (page 17), an authoring environment, and an asset management system on which they're "working closely with Apple." Aside from the announcement of RAVE, Apple's new cross-platform 3D API, this is the only indication we've seen that Apple is aware that the market they once ruled is being usurped (stay tuned).

Meanwhile, Web authoring is a hot topic. It seems that anyone with an interactive authoring tool is announcing a runtime plug-in for Netscape 2.0 and talking about Java programming environments.

So in addition to taking an in-depth look at Softimage 3D 3.0 for NT, the first of many NT power tools for developers (page 68), we present a critical look at Adobe's PageMill Web authoring tool (page 76) and another installment of our "Building a Web Site" series on Java applets (page 53). For good measure, we've thrown in technical editor Guy Wright's treatise on current and emerging mass storage technologies (page 26), a tutorial review of ElectricImage 2.5 (page 58), and a look at Sega's proprietary audio development tools (page 88).

Speaking of Guy Wright, I'd like to welcome him as a full-time member of the *InterActivity* staff. Guy had been contributing to these pages in his spare time, while his day gig was running the development side of Miller Freeman's in-house CD-ROM department. Previously, he was technical editor of *OS/2 magazine* and before that the founding editor of *Amiga World*. He still operates a CD-ROM development house.

Two last points of interest: The winged guy on our cover was designed and produced by Industrial Light & Magic on both the Irix and WinNT versions of Softimage. And Chris Landreth's *The End*, profiled by Animata columnist Mark Giambruno on page 94, was nominated for an Academy Award just before we went to press. We wish him luck — though by the time you read this, we'll all know who got the Oscar.

Enjoy.

Dominic Milano
Editor

InterActivity™

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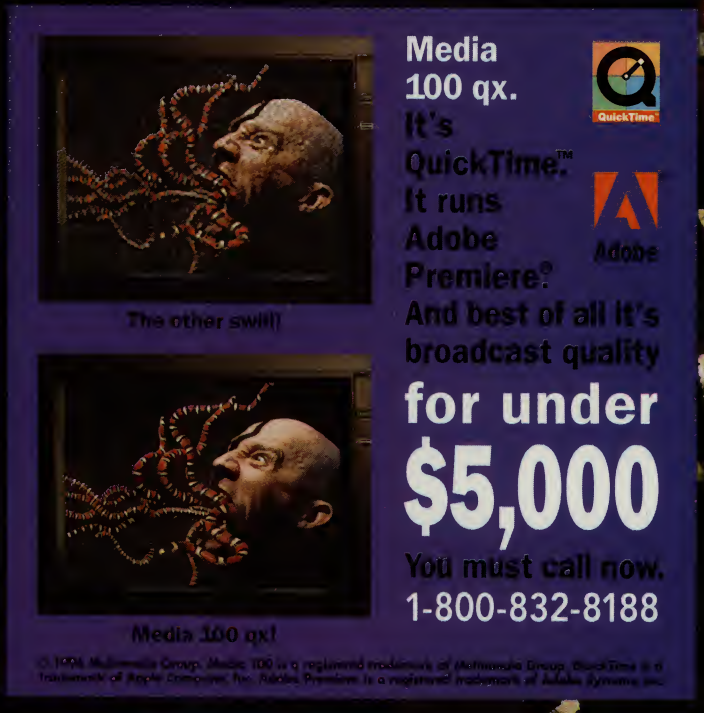

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Web Decency

In our March '96 issue, Robert Gelman urged readers to make their opinions heard on the eve of the Communications Decency Act amendment to the Telecommunications Bill. So far, we've received only two responses. Which tells us that either you're voicing your opinions elsewhere, or developers aren't concerned.

As a parent, I believe that certain material should be kept from those of an impressionable age. However, I think it's a parent's job to oversee what our kids are doing. Unfortunately, too many federal agencies have stepped in to tell us how to raise our children and that we are not allowed to discipline our children the way we see fit. If at all possible, those providing adult material should be careful as to who they allow into their sites.

I disagree with government involvement but I believe that we in the Internet community, not the government, have an obligation to control the environment we have established.

Dave (no last name given)
via the Net

Jan. 31, 1996, one day (actually one and one half days cuz time zone) before U.S. Congress finally spit out that telecom bill to President Clinton, Japanese police went to the offices of a Japanese Internet service provider, Bekkoame, and to two of its users' homes for the criminal investigation of pornographic material exchanged through its Web site. Several hard drives and machines were confiscated. Japanese TV stations and newspapers rushed to cover this incident because it was the first negative story about the Internet.

Bekkoame is still able to run their server and is expressing the importance of morality and freedom in their statement of Feb. 1, 1996, (http://www.bekkoame.or.jp/info/osirase.html). They are also trying to continue their non-restriction policy, but it seems the police are closely monitoring the site. This incident worries many online users in Japan, because until this time they were not aware that such enforcement really happens in Japan. Some users are starting to consider using encryption, and some providers like AsahiNet have started showing a good-boy attitude, as shown in their statement (http://www.asahi-net.or.jp/asahinet/attention-j.html). By the way, these statements are written only in Japanese.

Gohsuke Takama
Japan
via the Net

Gould Rules

As with the first three issues of *InterActivity*, I had no hesitation in purchasing your January '96 issue. To my relief, it was once again worth every cent. Eric Justin Gould's column on Interface Design entitled "Connecting Participants to Content : Five Styles of Engagement" was superb. I have been looking for books and articles on interface design for ages, and either they were too simple or simply too expensive to buy.

The article was concise, understandable, and contained excellent information on the different styles of interface, as well as ideas for implementation. I look forward to future installments on this topic.

Grant Young
via the Net

BeBox Bits

By strange coincidence, the March *InterActivity* showed up moments before my BeBox arrived. I very much enjoyed John Worthington's column on programming the BeBox and am really glad to see a major magazine like *InterActivity* paying attention to the Be computer.

Arne Claassen
Duthie Associates
via the Net

Good article on your BeBox experience — sounds like an interesting platform. Here are further suggestions on debugging multithreaded code from someone who has created and squashed many perverse timing bugs in his time!

Debuggers are pretty lame for multithreaded apps because they change the timing.

printf() is the way to go, but having a central print semaphore does the following:

• Prints all your messages out cleanly.

• Creates priority inversion, because all tasks that use printf() are now queued on a single system resource. (Sort of like having rich people wait in the bread lines like everyone else — a worthy ideal in itself, but unfortunately not realistic . . . but that's another discussion.) This has the effect, in many cases, of masking out timing problems that would otherwise be immediately obvious.

Effective ways to use printf() include:

• Have all the printf()s come out simultaneously, but use small messages.

printf("D19_%f\n",myfloat);

is much less likely to be broken up than

printf(" *** Debug point nineteen *** myfloat = %f\n\n",myfloat);

• Use setbuf(stdout,0) & setbuf (stderr,0) to ensure that the compiler doesn't use C buffering (characters are flushed right away). This is crucial, because without it the display of characters will lag behind when the actual printf is performed in the code, which can be very confusing.

• Use a combination of timestamps and different standard out/standard error paths for each task — you avoid garbled printf()s, and you can follow the timing of everything exactly. The following macro, although not beautiful, may be helpful.

```
int debug = 1;
time_t globaltime;
char timestr[80];

#define TRACE(v,x)  if (debug >= v) \
{ \
   time(&globaltime); \
   sprintf(timestr,"%s",ctime(&globaltime));\
   timestr[strlen(timestr)-1]=NULL;\
   fprintf(stderr,"%s ... %s\n", timestr,x);\
}
```

Of course, it is a testament to the quality of my initial work that I got good at these. Hope they're helpful.

Brad Dobson
Varian
via the Net

Car-ections

In an otherwise fine article, on page 35 of your January 1996 issue there appears an article called "Shell Oil's Dancing Cars." In it, some images from Viewpoint DataLabs are shown. In the body of the page in Figure 4, the author shows a texture mapped view of the same car, distorted by software, but says: "The car started life as a regular Cadillac. . . ." The car pictured (wireframed in Figure 1), is actually the classic '57 Chevy.

Otherwise, great magazine. Good articles all around. Aloha oe!

Brian Weaver
GraF/X Studio
via the Net

Actually, R/Greenberg Associates told us it was a Caddy, but our own Viewpoint catalog showed no such animal. So we grabbed the wireframe '57 Chevy. As you noticed and Viewpoint confirmed, the Chevy was the dataset used in the commercial.

Quick (VR) Fixes

I enjoy your fine magazine and found the QuickTime VR article in March to be a good one, but the QuickTime VR sequence printed on pages 36 and 37 was mistakenly attributed to Mike Radu when, in fact, I created it.

David Palermo
Systems Engineer
Publishing/New Media/Entertainment
Apple Computer

Oops. Thanks for bringing the mistake to our attention. Looking at Apple's site now, it's easy to see how the mistake happened. Directly above your entry is Michael Radu and Metech's link to a step-by-step tutorial on using Bryce. We simply confused the names. Our apologies.

Crush Credits

Thanks for creating a valuable resource for the multimedia/Web development community. *InterActivity* is an excellent publication. But in the sidebar article on page 30 of "The Making of *Crush*," you spelled my name wrong. It should be Marvin, not Martin, Scaff. Also when I originally spoke with the author I gave her the names of the engineering team at HOT that finished the product. They are Damien Miller, Seth Restaino, Paul Czyzewski, and zuzu P. Spadaccini, who led the project until the alpha release. The article made it sound like I should have a cape and a big S on my chest, but in reality I had the help of a very competent team, without whom *Crush* never would have shipped.

Marvin Scaff
Director of Engineering
Hands-On Technology

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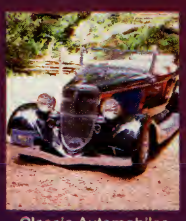
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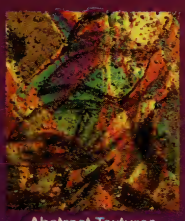
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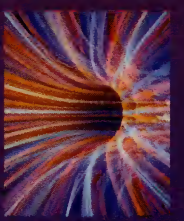
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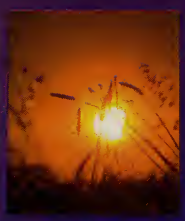
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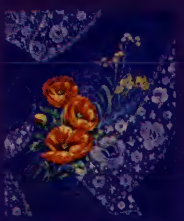
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RUN TIME

Rumor Has It

Compiled by Erica Smith

Popular consumer-oriented online services such as **America Online, CompuServe,** and **Prodigy** are evaluating their current content providers in terms of their value and being more selective of the providers they sign up. Content providers may be given the boot if they aren't profitable. Ideally this will motivate content providers to be more creative. Future business deals are likely to be affected by this move. Online services may invest more in the partnering companies in return for a controlling interest. . . .**Manley & Associates**, developer of interactive educational and entertainment software, was acquired by **Electronic Arts** and will henceforth be known as **Electronic Arts Seattle, Inc.** The CEO of Electronic Arts, Larry Probst, disclosed that this latest acquisition is one step in a long-term strategy to acquire creative talent. Manley indicated that the consolidation was motivated by a need for more capital to invest in 32-bit technology. . . .**Dataware Technologies** acquired **Ledge Multimedia** in a move to offer more Internet and CD applications. Ledge is responsible for developing specialized multimedia applications for companies such as Philips Media, Houghton Mifflin, and public TV station WGBH of Boston, Massachusetts. Recently, Ledge announced *Gutenberg II*, a multimedia publishing system based on a suite of proprietary tools for developing low cost, high production value multimedia products . . .Three on a Match? **Sumeria**, **Fujitsu**, and **Universal Magic** have agreed to collaborate on marketing and development to take advantage of Fujitsu's strength in Japan. The focus will be on MPEG products, high capacity disk formats, and Internet distribution. . . . **Corporate Vision Inc.** (CVI) has signed a letter of intent to purchase **Inter Active Media** (IAM). The deal gives CVI holding 100% of InterActive Media's common stock. IAM receives an undisclosed combination of cash and stock in CVI. Both companies develop corporate multimedia sales and training applications. . . .**Rom Tech** and **Virtual Reality Labs** are planning a merger whereby Virtual Reality will become a subsidiary of Rom Tech in exchange for 1.3 million shares of Rom Tech common stock

Continued on page 14

Friend or Foe:
A NEMESIS IS MADE

Be prepared for panoramic views, lots of texture, and a sense of the macabre. Wait, did you say *Zork*? The infamous series of text-based *Zork* games has a long history, including being the first interactive computer game on the market. The creators of the newest game, *Zork Nemesis*, have gone over the top to bring their audience an immersive adventure mystery with plenty of puzzles and graphics that far surpass their last effort. This time, 3D allows the player to become surrounded by the game, at least as much as possible while using a monitor with a mouse and keyboard.

The people at Activision, publisher of the *Zork* series, have a secret weapon — the Z-Vision engine. "No one has ever used this," says Cecilia Barajas, the producer/director of the game. "Other people have done similar stuff — Apple's QuickTime VR in *The Star Trek Technical Manual*, for example — but never in an adventure game." The difference? The degree of interaction in a 3D environment. Z-Vision is a 360-degree surround technology that incorporates a scripting language for 3D navigation.

To determine the look she was aiming for, Barajas studied the competition. The successful elements she gleaned included a seamless interface in *Myst*, beautiful artwork in *Gadget*, and a level of interaction in *Doom* that *Zork* had yet to achieve.

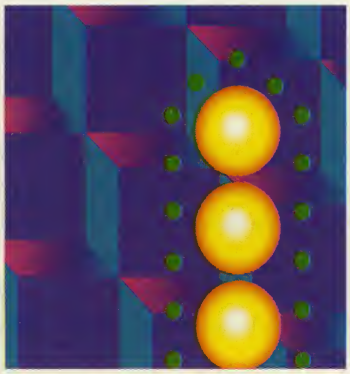
Z-Vision evolved naturally from Barajas's brainstorming. Programmers had to account for 3D graphics, rendering time, five playing levels, user interface, all the puzzles, and the logic needed to support them. The programmers wrote the engine in C++. The beauty of the tool is its flexibility. "Z-Vision can do the panoramas, display flat images, animations, play sound and animation in sync. With this tool, you're not aware that you're playing an animation," says Laird Malamed, technical director/wizard for *Zork Nemesis*.

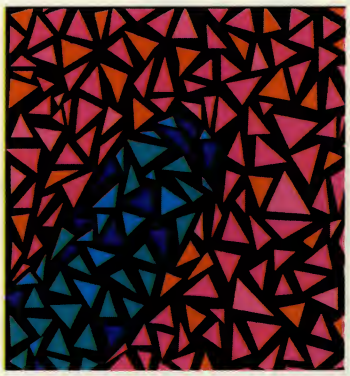
During the past 18 months, the *Zork* team put in long days and late nights with plenty of brainstorming sessions to fuel their creativity and ingenuity. Inhouse, 26 employees made up the *Zork* force, and the project employed three art houses which involved more than 20 artists. Of course, all of this didn't come cheap. Activision called this a "multimillion dollar production."

The team worked on SGI workstations, Pentium PCs, and Macs using Alias Power Animator and Strata Studio Pro. Their post-production tools include a DT Max composition machine and Ultimatte. Ultimatte was used directly on the set during shooting for compositing in real time. After shooting film, the images were placed in the game environment so actors could see immediately where they would appear, aiding their interaction with the *Nemesis* world.

The programming team worked closely with the artists to ensure the project went smoothly and quickly. "It really was a good synthesis in terms of taking the talents of two different disciplines and finding the best solutions," Malamed remarks.

Continued on page 14





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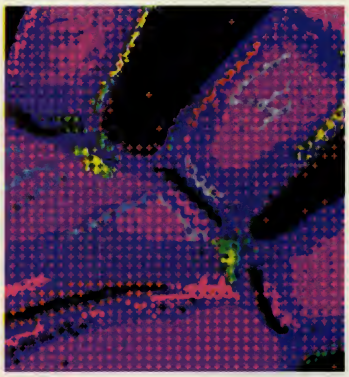


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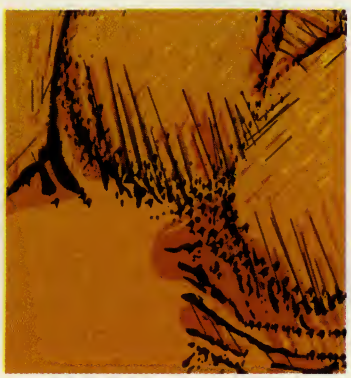

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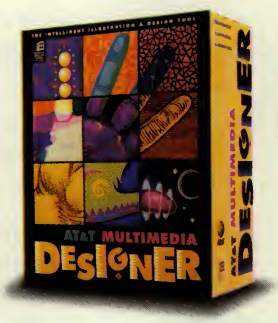

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READER SERVICE NO. 7

Rumor Has It

Continued from page 12

(valued at $10.4 million). Virtual Reality has received $250,000 in financing to help them along while the deal is in process. . . .Puzzle down. *Manic Maze!* is a new interactive online game from **InfoMedia's WorldVillage**. **Legend Entertainment** is sponsoring the Web site, which is played as a walk-through 3D maze. You can experience the site at http://www.worldvillage.com/maze.htm. . . .**Hollywood Online** (HOL) has become part of the **Times Mirror** machine. Available through most consumer online services, HOL provides information about movies, television, and music and offers creative and business services for the entertainment industry. Times Mirror didn't comment on the uses they had in store for HOL. . . .Giving a new twist to broadcast programming, **Superbowl.com** was one of the most successful online sporting events, scoring a total of more than 28 million hits between its inception Dec. 29, 1995, and the end of January '96. Using Microsoft Network servers and tweaked for Microsoft's Internet Explorer Web browser, the site was a partnership between **NBC**, the **NFL**, and **Microsoft**. . . .Art Feud for Thought. **Cascade Marketing** has released *The Hermitage Art Treasures Tour* on CD-ROM. Rights to the material were hotly sought after by Microsoft just months ago. Cascade was the first company to obtain the U.S. rights with a little help from some Russian programmers they befriended. . . . **Steve Hollis**, founder of the Multimedia Live conference that took place in San Francisco last October, passed away earlier this year. Our condolences go out to his family and friends.

Got News? Send it to *InterActivity*, 411 Borel Ave., Ste. 100, San Mateo, CA 94402; fax 415.655.4360; email interactivity@mfi.com.

Continued from page 12

Starting with test art and working on the rendering time with the programmers, the team struck a balance between what was practical and what wasn't. Several issues quickly became apparent. A tool was needed to script the puzzle logic and handle navigation within the game. Graphics needed special treatment to optimize speed.

One group worked on the engine and another worked on the script. They were a tag team of sorts, so that when the engine side developed a trick to get lava glowing, it could be applied by the scripting group to existing and future animations.

Malamed's team faced several challenges in the design of the game, common issues in game developers' work. Initially, he realized that the graphics would present a problem because of their size, causing the game to slow down. "We needed one image to represent 360 degrees and load it into memory, then manipulate it to create the effect of turning for the user. That's a lot of stuff to do simultaneously," Malamed says. They enhanced graphics performance by configuring the art to synchronize better with the way the image was read from memory.

Despite his intensive technical background, Malamed's challenge gave him insight into how computers work. "Sometimes they don't do what you want because you don't use them the way they're designed to work." Malamed quips. "By doing a simple change, turning the image and flipping it, we were able to triple our speed. The processors are set up to read chunks, and we weren't chunking our memory. Instead we were reading little bits here and there."

Sound and video syncing presented another hurdle. To play multiple sounds successfully, the programmers and audio people had to manipulate Windows threads and use a lot of trial and error to get the timing right. Meanwhile, the engine crew built a player around TrueMotion software compression from Duck Corp. This solution enabled them to develop the Windows 95 and DOS versions simultaneously with the same assets.

Porting to different platforms proved easy enough, especially when developing the DOS and Win95 versions together. These versions should ship by the end of March '96. The Macintosh version is slated for release a few months later — they're spending more time tweaking graphics for display on the Mac. Malamed notes, "There's a different feel to the colors and the gamma of the circuitry on the Mac. We want to make sure the look and feel is retained on the Mac."

One of the more unusual tools used by the Activision team was a font technology called Unicode. Unicode supports foreign language characters, making it a helpful localization tool. Malamed says, "Not many people know about it, including Microsoft, and they supposedly support it."

Unicode specifies characters in two bytes rather than one, making an enormous number of characters available. Activision identified text files by number, identifying each language with a unique code. Multilingual support, however, didn't extend to recorded dialogue.

The *Zork Nemesis* team regards this production as a starting point, so next time they'll be challenged again to produce games that reach farther out into the stars and galaxies — and who knows what other worlds — with better technology and more compelling interactive designs and content.

–Erica Smith

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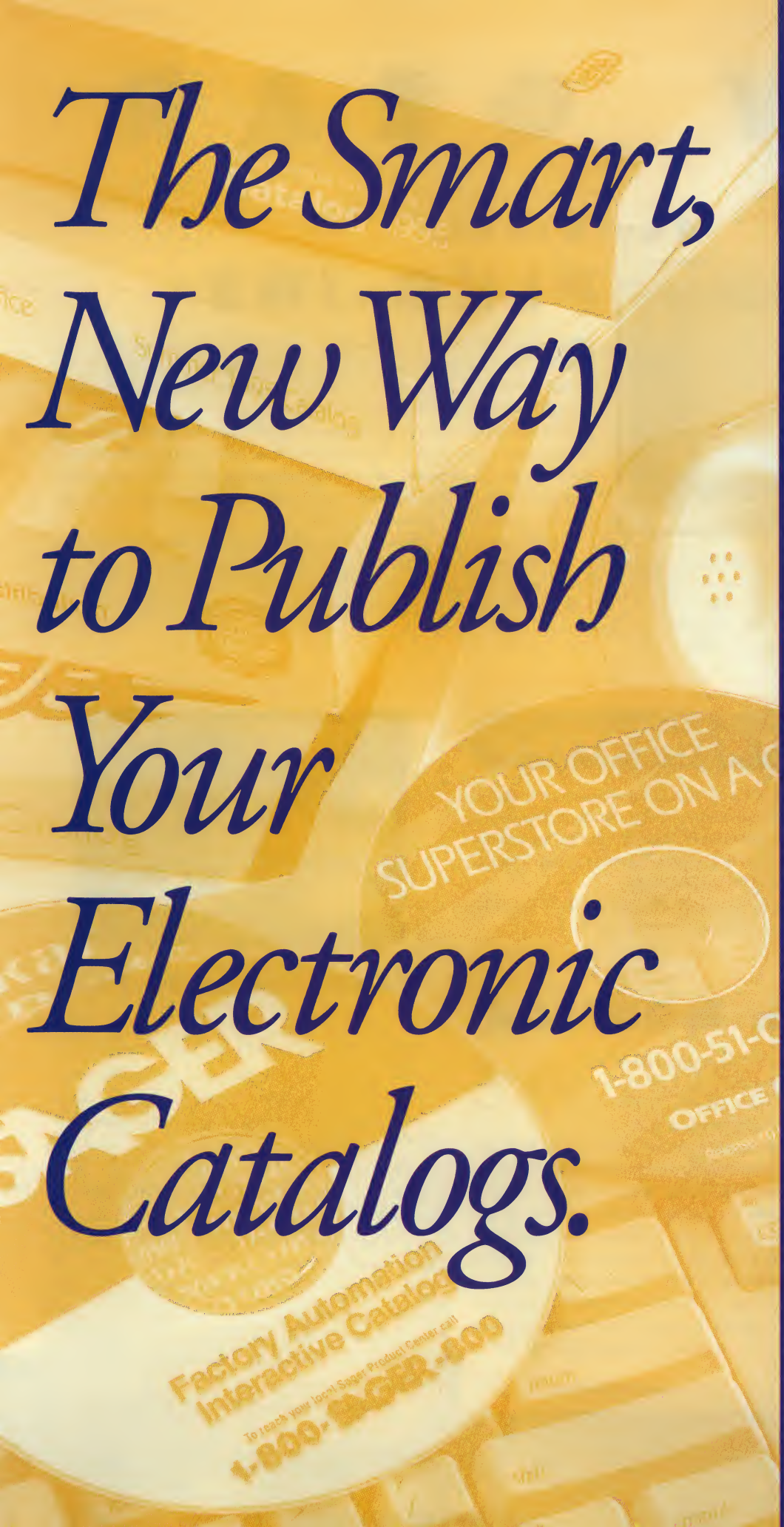

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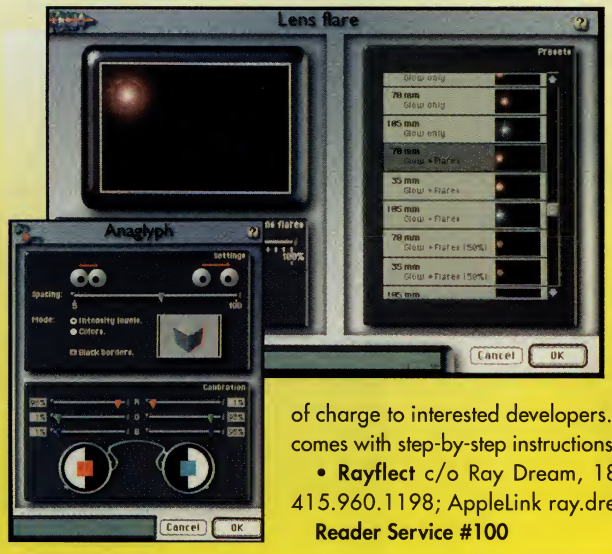
READER SERVICE NO. 8

NEW GEAR

Compiled by Ted Greenwald

Ray Dream PLUG-INS



Rayflect (distributed by Ray Dream) introduces the first plug-in extensions for Ray Dream's 3D modeling and animation programs, Designer 5 and Ray Dream Studio for both Power Mac and Win95 platforms. All Rayflect effects can be applied to both still images and animations.

Professional Lens Pack ($79) includes a group of plug-ins that provide camera and lens effects such as depth of field and lens flare. 3D Fun Pack ($29) comprises the Anaglyph, Chromadepth, and Auto Stereogram plug-ins. These stereoscopic processes are applied as post-rendering effects within the application. Anaglyph and Chromadepth 3D glasses are included.

To encourage plug-in development, Ray Dream offers an Extension Toolkit free of charge to interested developers. The Toolkit is an open, crossplatform 3D API for developing custom plug-ins and comes with step-by-step instructions. In addition, Ray Dream offers to distribute extensions via their direct mail catalog.

• **Rayflect** c/o Ray Dream, 1804 N. Shoreline Blvd., Mountain View, CA 94043; vox 415.960.0768; fax 415.960.1198; AppleLink ray.dream.

Reader Service #100

CAD File Translation

CAD Real-Time Link from Clarus AB enables users of various CAD applications on Silicon Graphics machines to export files to various realtime visualization applications. The "from" list includes Alias, IGES, Inventor, VRML, Open Flight, and STEP; the "to" list includes Open Flight, FHS, Inventor, VRML, and Vega Fast File formats. The latest version includes the ability to add radiosity, textures, DCS, and LOD to CAD data.

• **Clarus AB**, Stora Badhusgatan 18-20, 411 21 Goteborg, Sweden; vox 46.31.774.3780; fax 46.31.1354.71; email marketing@clarus.se; Web http://www.clarus.se.

Reader Service #101

Presentation MONITOR

Designed for large-group presentations such as sales meetings, training, and videoconferencing, ViewSonic's 29GA video monitor ($3,995) displays images from either a TV/video source or a computer on a 27" screen. The unit is compatible with Mac and PC computers, supporting RGB and S-Video component formats plus NTSC and PAL video. It accommodates pixel resolutions up to 1,024x768 with a refresh rate of 80Hz and offers adjustments including contrast, saturation, sharpness, color temperature, image size, and image position. In addition, stereo speakers are built in, powered by five watts.

Front-panel jacks interface with a laptop or camcorder, while rear-panel connections are provided for multiple video and computer sources. Several units can be daisy-chained via video and audio outputs. A wireless remote that can control multiple ViewSonic 29GAs, each displaying a different image, is included.

• **ViewSonic**, 20480 Business Pkwy., Walnut, CA 91789; vox 800.888.8583, 909.869.7976; fax 909.869.7958.

Reader Service #102

From NuBus to PCI

For those Mac mavens who have a substantial investment in NuBus hardware, Second Wave's Xpanse line of NuBus-to-PCI chassis may give your system a new lease on life. The Xpanse range enables NuBus cards to connect to PCI-based Macs and includes the two-slot PN200 ($795), four-slot PN400 ($1,094), and eight-slot PN800 ($1,795). The latter two models come with their own power supplies, a cooling system, and optional twin SCSI drive bays. All Xpanse models are certified to operate with PCI-based Mac clones from Power Computing and Daystar as well as Power Macintosh models.

• **Second Wave**, 2525 Wallingwood Dr., Bldg. 13, Austin, TX 78746-6932; vox 512.329.9283; fax 512.329.9299.

Reader Service #103

NEW GEAR

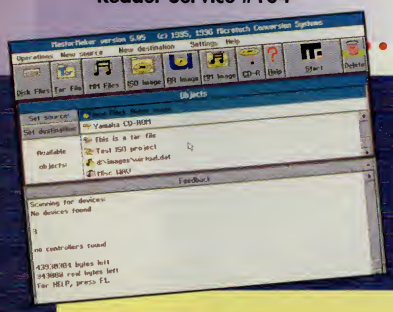
MPEG-2 Rising

Now that video compression is taken for granted, MPEG-2 is emerging as today's best option for broadcast and tomorrow's best hope for CD-based delivery. A new chip set from Mitsubishi should speed the process by providing high performance, high integration, and fewer chips, thus lower cost.

The ensemble ($6,000 per 1,000 pieces; motion estimator only $500 per 1,000) comprises one controller chip, one pixel processor, and four to eight motion estimators, depending on search window resolution required. Boasting a dual 32-bit bus architecture and hierarchical pipeline scheme, the chipset supports all MPEG-2 prediction modes; I, P, and B frames; and the ITU-R-601 standard for encoding 30 frames per second at 720x480 pixel resolution in real time. Furthermore, it provides ML@MP (main level at main profile) encoding with scalable search windows at half-pixel resolution. Commercial samples are available, and an evaluation board is offered for $7,000.

• **Mitsubishi**, 1050 E. Arques Ave., Sunnyvale, CA 94086; vox 408.730.5900; fax 408.732.9382.

Reader Service #104



FREE CD-R SOFTWARE

MicroTech offers an ISO 9660-only version of their MasterMaker CD-R premastering software, which runs with a GUI under DOS and premasters CDs for Win95 and WinNT, free of charge. Red Book and Mixed Mode versions are also available (prices TBA), and a Rock Ridge version ($2,000) produces Unix-compatible discs.

MasterMaker accepts long file names and includes a browser for streamlined file selection. It tests the CD master before burning and displays job progress during testing and burning. It can produce a master even when running on a system that lacks a CD-R drive. In addition, users of MicroTech's own CD-R duplication systems can duplicate directly from images created by MasterMaker.

• **MicroTech**, 940 Industrial Ave., Palo Alto, CA 94303; vox 800.223.3693, 415.424.1174; fax 415.424.1176; email info@microtech.com.

Reader Service #105

A WORKSTAT

As digital production techniques become standard practice throughout the entertainment industry, several companies have responded with a new generation of computers tailored for the rigors of realtime media generation, capture, manipulation, and playback.

These machines are modular, upgradeable, and expandable; equipped with interfaces for Ethernet, SCSI-2 Fast, PCI, video, and audio; and sometimes feature parallel processors. (For maximum performance, applications must be coded specifically to take advantage of multiprocessing.) They're configured as systems, with standard 4X CD-ROM drives, AV-capable hard disks, gobs of RAM (including video and textures RAM), and numerous card slots and drive bays. You can expect the OS to come preinstalled and possibly applications as well.

DayStar Dynamite. Since last year's introduction of the Intel Pentium Pro processor, much of the action has focused on Windows NT. Now Mac users have access to the same kind of power thanks to DayStar's Genesis MP, the first Mac OS system with parallel processors. Aimed at prepress, image processing, 3D rendering, animation, and digital video, the basic Genesis MP system includes four PowerPC 604s running at 132MHz, 16MB RAM, 512kB secondary cache, 1GB hard disk, 4X CD-ROM drive, mouse, and keyboard (estimate street price — *not* retail — $15,000). The tower case houses up to 12 DIMMs (for up to 1,500MB RAM), nine disk drives, six PCI cards, Ethernet connectors, Composite and S-Video connectors, stereo audio in/out, and two GeoPorts.

DayStar reports a 4X speed increase over machines that use a single 604 when running a multiprocessor-aware version of Adobe Photoshop. Other applications that have been announced in multiprocessor versions include Adobe Premiere and After Effects 3.0 (via free plug-in software), Deneba Canvas 5, and Strata Studio Pro Blitz and MediaPaint.

Intergraph Interactive. Intergraph's latest WinNT workstation line, StudioZ ($27,095-$71,995 without monitor), is targeted toward animators and video producers. Models range from one to four Pentium Pro processors running at speeds between 180MHz and 200MHz. All configurations come bundled with Windows NT, Studio Z Console for video, Adobe Premiere LE for Windows, Adobe Photoshop 3.0 LE for Windows, Macromedia Sound Forge, and PC-NFS for interoperability between WinNT and Unix. Applications reported by Intergraph to take advantage of multiprocessing include Autodesk 3D Studio Max, In:Sync Speed Razor, North Coast PhotoMorph 2.0, and Adobe Photoshop 3.0.4.

NeTpower News. Replacing their very capable MIPS-based systems, NeTpower now offers the Calisto line of NT workstations ($5,295-$18,995) based on 200MHz Pentium Pro chips. Calisto comes in configurations designed for video, MCAD, and Web server applications. Systems feature between 32MB and 256MB RAM, a 256kB Level 2 cache, up to 4GB hard disk, 6X CD-ROM drive, your choice of NeTpower's own OpenGL graphics accelerator boards specially tweaked for NT and the Pentium, and a Creative Labs Soundblaster Pro with powered speakers as well as keyboard, three-button mouse, and floppy drive.

Aspen on DEC. Aspen builds three lines of WinNT workstations based on Digital Equipment Corp.'s Alpha processors: Alpine ($7,982-$10,510 including monitor with a 275MHz Alpha 21064A), Telluride ($11,581 including monitor with a 275MHz Alpha AXP), and Timberline ($12,380-$19,808 including monitor with either 266MHz or 300MHz Alpha 21164). All models come with 4X CD-ROM drive, 1GB SCSI-2 Fast hard disk, 4MB PCI video adapter, and floppy disk drive. Options range from 16MB to 64MB RAM (up to 521MB capacity), 2MB secondary cache (up to 16MB capacity), and various configurations of PCI slots, drive bays, and network connections.

Digital's Domain. Designed for demanding applications from multimedia development to financial trading, Digital's Personal Workstation is a turnkey

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WinNT system offering the following choice of processors: 100MHz Pentium ($3,529), two 100MHz Pentiums ($4,379), 120MHz Pentium ($3,629), 133MHz Pentium ($3,879), two 133MHz Pentiums ($5,229), 233MHz DEC Alpha ($5,395), or 266MHz Alpha ($5,995).

Standard equipment includes 16MB RAM (with Pentium) or 32MB RAM (with Alpha), 2MB video RAM, 1GB hard disk, and 4X CD-ROM. Matrox's Millennium Graphics Adapter is also included, with optional S3 Diamond Stealth 2D and AccelGraphics 3D graphics accelerators. Upgrades to faster Intel or Alpha chips are available.

• **Aspen**, 4026 Youngfield St., Wheat Ridge, CO 80033-3862; vox 303.431.4606; fax 303.431.7196; email aspen@aspsys.com.
Reader Service #106

• **DayStar**, 5556 Atlanta Hwy., Flowery Branch, GA 30542; vox 770.967.2077; fax 770.967.3018; Web http://www.daystar.com/.
Reader Service #107

• **Digital**, One Digital Dr., Merrimack, NH 03054; vox 800.344.4825, 603.884.5111; fax 800.676.7517; Web http://www.digital.com.
Reader Service #108

• **Intergraph**, CR1102, Huntsville, AL 35894-0001; vox 800.763.0242, 205.730.2000; fax 205.730.6188; Web http://www.intergraph.com/ics.
Reader Service #109

• **NeTpower**, 545 Oakmead Pkwy., Sunnyvale, CA 94086; vox 800.801.0900, 408.522.5199; fax 408.522.2666; email info@netpower.com; Web http://www.netpower.com.
Reader Service #110

SGI HANGS TOUGH

To judge from the heightened flow of information from Mountain View, California, the potshots taken by the unholy cabal of Intel, Microsoft, Intergraph etc. have had their effect. Most recently, SGI lowered the price of their entry-level Indy to $6,449. The machine is powered by a MIPS R4600 chip and includes 32MB RAM, 500MB hard disk, 17" monitor, and SGI's own 8-bit graphics hardware with software dithering for a true color effect.

But there's more to it than price cuts. Across the line, SGI machines are getting a boost from two new chips by SGI subsidiary MIPS. The R5000 and R10000 are a step up from the R4400 and the R8000. The R5000 will be found in SGI's Indy and Indigo2 Impact while the R10000 replaces the fastest MIPS chip, the R4400, in the Onyx and Challenge series. The Power Challenge 10000 will incorporate between two and 36 R10000s, the Onyx InfiniteReality between two and 24.

SGI's strategy has been to accelerate graphics processing via custom ASICs, first used in the Indigo2 Impact. SGI is adding three new computers: IndyStudio ($13,495) for digital video, interactive 3D, and Internet work, Indigo Solid Impact ($27,000 with R4400, $34,000 with R10000) tweaked for 3D modeling, and Onyx InfiniteReality ($125,000 single processor, $208,800 dual processors).

A 275MHz R10000, promised for late in the year, comes with reported Spec95 ratings of 12 SPECint95 and 24 SPECfp95. The 200MHz R5000 scores 5.5 on the SPECint95 and 5.5 on the SPECfp95. For comparison, Intel's 180MHz Pentium Pro scores 7.20 SPECint95 and 6.10 SPECfp95. SGI expects even higher numbers with the new 64-bit compilers due this year. *—Kathleen Maher*

• **Silicon Graphics**, 2011 N. Shoreline Blvd., Mountain View, CA 94043-1389; vox 415.960.1980; fax 415.961.0595; Web http://www.sgi.com.
Reader Service #111

INVERSE INK'S

REFLUX COMICS

► HOW INVERSE INK INTEGRATES KUNG FU MOVIES INTO A CROSSPLATFORM CD-ROM COMIC BOOK SERIES AND DEVELOPS TITLES ON INCREDIBLY TIGHT BUDGETS.

COMIC BOOKS ARE BIG BUSINESS.

BY KATHLEEN MAHER

They place high on the ladder of cultural cool. The best titles offer stunning artwork combined with intelligent, mature storylines. Baby boomers who grew up collecting classics by Stan Lee and Jack Kirby, Neil Adams and Denny O'Neil, and all the rest need no longer fear reproach from the bullies and parents who called them geeks for reading funny books — those who kept their collections from the '60s and '70s are laughing all the way to the bank. ■ If you've been away from comics, revisiting them in the '90s can be something of a shock. The days

of the 10¢ comic book are long gone. Nowadays, a monthly will run you a couple bucks. A graphic novel might cost $20. Dime store comic racks have been replaced by wall-to-wall specialty store displays of every genre of comic imaginable.

Comics met digital media back in the '80s when Joe Sparks used MacDraw to produce *Zero Tolerance*, the first entirely digitally generated comic book. It was printed on paper. Almost 10 years later, comic books went interactive (barely) for the first time on CD-ROM with *Dinosaurs for Hire* and *Ninja High School* by CD Comix for Commodore's CDTV and later Mac. They sold for $24.95, cost almost nothing to produce (the material was scanned line art from the print versions supplemented with voice-overs by acting school kids), and sold all of 250 copies.

Inverse Ink of Mountain View, California, joined the interactive comic book revolution in 1995 when they released *Reflux: The Becoming*, the first in a series of crossplatform Mac and PC CD-ROMs. A second issue followed at the end of the year, and the third is about to come out. From a developer's point of view, the story of how they're doing it is a fascinating one. *The Becoming* was built by a staff of eight people in nine months. Subsequent issues are being produced in about four months by teams of five at a cost of $50,000 per title.

The story so far. . . .

Developers with a Mission

Inverse Ink grew out of Tao research, a company owned by Dr. Lingtao Wang, who was willing to give self-described comic book fanatic James Harvey and his crew a shot at creative development. Harvey was convinced that the secret to creating a successful interactive comic book lay in the graphics. If a way could be found to create lots of animation economically, titles could be sold cheaply enough to be as broadly popular as hand-held comics. In the process of giving birth to *Reflux: The Becoming*, Harvey and company found the secret to plentiful film clips.

From the start, Dr. Wang and Harvey were drawn to China — Wang because he is from Taiwan originally and Harvey because he studied Chinese in college. The two traveled to China where Dr. Wang's contacts opened many doors, the most important being the Beijing and Shanghai film studios where they bought several Chinese kung fu films lock, stock, barrel, and rights. Voila! Action.

Why not Hong Kong? "That's what you would think," concedes Harvey, "but the films were too expensive there. We went to these great studios in Beijing and Shanghai that were founded in the '40s. They're a huge producer of kung fu films. We were able to get the five best movies for about $1,000 each."

At this point, it's important to remember that multimedia is the synthesis and remolding of several art forms to create another. Harvey's approach doesn't just extend the comic book form, it marries it to another: film. The alternative approach is simply to scan 2D comics into a computer and then add as much animation and sound as budget will allow (the approach taken by CD Comix). For many houses, that may not be much if you want to sell titles at competitive prices. *Reflux: The Becoming* sells for $19.95.

The Storyline

So what about the comic itself? The story is simple enough. It's right out of the cyberspace worlds created by William Gibson and his followers. You're living in the future, you're a computer kinda guy, and because there's a whole cyber universe in your computer, you're powerful. In the case of Flux (the hero of this tale), these powers manifest themselves in mean kung fu fighting ("my foo ware is strong," says he) and the ability to change shape. Flux, so the story goes, wrote the program for "identity in the 'verse" (as in universe). As a result, he has the power to change shape in his digital existence. The part of the 'verse in which our story takes place is Hong Kong GUI. It's a storyline that allows the basic cyberpunk/computer guy hero Flux to undertake glamorous adventures of espionage and intrigue in the digital world without too much reliance on credibility. Also, Flux's ability to change shapes gives the creators of *Reflux* enough flexibility to work in all these cool Chinese action movies.

This latest attempt at the digital comic book has much to be said for it. Readers fly through traditional comic books in minutes only to hunt (or worse, wait) desperately for the next issue. *Reflux* keeps readers around for a while thanks to a command bar at the bottom of the screen that lets the story be told from three points of view: that of Flux; his trusty sidekick computer; and the bad guy, Roark, an evil corporate headhunter willing to kill, maim, and lobotomize anyone who gets in his way. Each page is basically the same regardless of who is telling the story, but clicking on different points of view gets you different dialog (which is communicated via text in balloons as well as audio). Clicking around on the frame pays off pretty well, too. Certain frames are linked to video clips (digitized film) that come to life with a click of the mouse.

Reflux looks good. Artists Brian Wanamaker and Andrew Hsu have created a look closely related to Japanese *manga* and Japanese animation, yet they also remain true to the Chinese kung fu films and their own cyberpunk style. The setting is lush and exotic, as it should be, a stylized vision of the mysterious world that exists in our heads as a result of watching way too many Tsui Hark, Jackie Chan, and John Woo movies, not to mention all the comics, sci-fi novels, and other high-class literature we consume. All art forms meet here in Hong Kong GUI, where the traditional and noir collide in cyberspace.

The Creation of Reflux

The Inverse Ink team develops on Pentium PCs — they've got about 15 Pentiums and two or three Macs. Most machines run on 32MB RAM and have at least a gig or two of hard disk space. They use Macromedia Director to integrate the comic.

On the surface, *Reflux* looks like a traditional comic book. When the reader clicks on a panel that has video associated with it, the graphics melt into the video. The panels were created as traditional 2D pages and scanned in. "Then we color it in Photoshop," explains Greg Armanini, executive producer at Inverse Ink. "Then, based on those, we create the animations. We use Elastic Reality, Animator Studio, trueSpace for our 3D, and we actually take all that over to DeBabelizer and knock it down to 8-bit. And then we send that to Director."

To create the video sequences, the creative team digitized using Intel Capture and processed clips in Adobe Premiere. Finally, they used Elastic Reality to marry graphics with video and to accomplish the transitions.

"There's a challenge for anyone who's a developer these days to take a movie and re-appropriate it," says Greg Armanini, executive producer at Inverse Ink. "In retrospect, I'd say we were better off than a lot of other people because we can take that movie out of context and it actually works." Each page in *Reflux: The Becoming* has three video clips. By clicking on panels, the graphics turn into film segments from Chinese kung fu films. The control bar lets users get clues or view the dialog balloons from the perspective of another character.

"The most difficult part of combining video with computer graphics is dealing with the color palette," Armanini says. "It's such an art-intensive project, it has to show well. Dithering helps to some extent, but it really tends to look hokey when you have a lot of textures. Then we compound the problem because we have so much video on the same page — it's not like we cut away to a new page for the video. It occurs right there, and as you can see in the video, it's pretty poor quality and always radically different from the pages. If we're lucky, we can get video that matches the theme of the story at that point in time, so you can color according to the video, but sometimes the video we have is bright and sunny outside and we're at the darkest point in the comic book.

"We're in a Catch-22. We want to tell a good story, but it has to look good because, obviously, it's a technology-driven medium. We just try to optimize the video as best we can. I guess it's a lot about craftsmanship. We get the right people in there tweaking everything, and mixing and matching stuff. So far, it has looked pretty good."

The challenge starts at the beginning, with the artists working in true color. "They have to be very cognizant of the fact that we only have 256 colors," Armanini explains. "We develop a palette for every page of our comic book. So they know they're going to have to choose their coloring for one direction or another. Essentially, we end up with palettes becoming mood-aiding devices. They have a dark scene, they start to color it that way. We start there, and we're very careful about how we create our superpalettes that you see again and again and again. And we work hard in Photoshop and knock it 'til we get it right.

As it turns out, the panels are pretty dark, which probably helped in matching the videos, but to the viewer, some animations are also dark and therefore confusing. Video capture is an area in which the technology has improved dramatically, and Armanini believes the problem to be less of an issue in the next title, *The Threshold*. Armanini shot some of the video in *The Threshold*, which helps quality as well.

"When I lit the scene, I made sure that everything was somewhat flat — we used a wall that had one color in it, essentially," Armanini says. "We could make the scene look drab, but we could also make it part and parcel of the story and make it look motivated. That saved us a lot of colors and also made it look less lossy because we didn't have to compress as much. That's where the craftsmanship comes in — when we do those kinds of things at the production level. Your hands are really tied when you realize you have 64,000 colors and there are 256 that you're going to end up with. There's no real decent way to knock it down. You just have to set yourself up well."

In the first book, *Reflux: The Becoming*, the Inverse team used three of the five movies obtained in China. They'll use up the rest of the films in the next issue. The pacing and incorporation of the videos will be

different next time. Armanini explains, "Last time, we were more rigid. We had three videos and three graphics for every page. This time we're making it more random."

They've also incorporated 2D cel animation that they'll combine with the still graphics to create a more animated whole. Armanini has other tricks up his sleeve as well. "This time, we introduce a 3D villain who takes the place of Roark in the first one, and we incorporate him in front of the videos."

The writing process evolves concurrently with all aspects of development. As Armanini puts it, "I just make the story up as I go along. I watch the films and pick the video clips I want to use and map it out."

The Inverse team's storyboarding technique involves the use of such specialized equipment as yellow sticky notes. Armanini sketches the story and identifies which panels will incorporate video, which will be graphic panels only, and which will incorporate 2D animation. He makes crude sketches and puts a yellow sticky on each panel marked V for video, G for graphic, or C for cel animation. Then the storyboard is sent to the artists for a more fleshed-out depiction and to the writers for their input.

At first, Armanini's biggest worry was the quality of the work he had to deal with. He freely admits to not being a comic book fiend like Harvey. "I was kind of worried using these B-grade movies, but it works out fine. The B movies, of course, have absolutely nothing to do with anything that we're doing. So we're inherently working out of context. And I don't think it's so much that they're B-grade movies. There's a challenge for anyone who's a developer these days to take a movie and re-appropriate it. In retrospect, I'd say we were better off than a lot of other people because we can take that movie out of context and it actually works when it's integrated with the story and the characters. I think that was my initial fear: can I keep doing this over and over again and keep selling it? And we can. But as far as quality goes, there were always some issues because we're at the mercy of our content providers."

Armanini recently returned from another trip to China to get a few more movies. Unfortunately, they had subtitles. "I kept asking them, 'Can you guys give me a new print without the subtitles? I can't use these.' And they're like, 'Sorry, we bought this from someone else and this is the only print we have. We figured you'd like it that way.' There are obviously challenges that come with using these types of movies. Now that we've got this thing under wraps, I think it's more fun than anything. We get a real kick in the pants from doing this. Now we're working on character development."

That's not a bad idea. Some of the most tantalizing aspects of the first title were the possibilities inherent in the characters of bad boy cyberpunk Flux, lovely kung fu lady Silk, wisecracking sidekick Horse, and the evil Roark. In general, the action moved from one kung fu encounter to another. To be fair, in the world of comic books, stereotypes are archetypes and therefore certainly excusable if not required. Nonetheless, the next issue of *Reflux* will not be damaged by giving the characters more depth. In the first title, the reader tends to hunt around for the "good parts," i.e., parts where someone gets kicked in the face. Thanks to the magic of the computer and the Chinese economy, plenty of people get kicked in the face and elsewhere.

"I don't think we'll ever steer away from the kung fu because that's the heart of it," Armanini says. "That's really what drives it."

Clicking on the file folder unveils character databases and other clues about the action in *Reflux: The Becoming*.

Deciphering Distribution

Driving the distribution machine, however, is a new set of challenges. Currently, the *Reflux* series is sold by subscription and appears in some comic catalogs such as Diamond Comics Distributors. It's also in computer and comic book stores. Inverse Ink has shipped 30,000 copies of *Reflux: The Becoming* and another 30,000 copies of the second comic in the series, *Reflux: The Threshold*. About 5,000 copies in each shipment were Macintosh versions. *The Becoming* has been selling a couple of thousand copies per month, Armanini says. Numbers aren't in yet for *The Threshold*. They've also made a demo version that contains multipage samples of the first two comics and sells for $1.99.

"The computer channel is funny," Armanini says. "You only have a given shelf life. Of course, I'm on the production side — I'm a little naive — but I was thinking, I can give them four products and they'll put all four on the shelf at once. You never know what's going to happen at a given store. People are really concerned with how much they're going to get out of a given amount of shelf space. For someone selling CD-ROMs and getting, on average, $50 or $40 a title, this much shelf space is worth X amount of dollars. We give them $10 to $20 titles. It's gotta move for them to rationalize giving us shelf space. So I think the biggest problem we're having is educating the customers, so they just go in there and snatch it up on an impulse buy.

"My feeling is that the day we're able to convert the computer market to a consumer market, we're all going to be a lot happier. We realized, why try to convert the computer people? Let's try to convert the comic people. And that's what we're trying to do. We want this to be an everyday feeling product, and we don't always want to be obscured on the shelves at Fry's computer store or whatever. We want to stand out and be unique. We have a totally new genre. Besides having a new price point, we have a whole new way of telling a story and entertaining kids and adults.

"We've been going through a learning curve about how this is going to work and what the future of it might be. We're starting to change

our model a little bit. We're starting to look a lot more like a comic book — in general shape and in concept."

Soon, comics from Inverse may also be in supermarkets and variety stores. They're considering repackaging their products and getting into special racks for in-store displays. So is the *Reflux* packaging in for a major redesign? "The jury's still out on what we're going to do with respect to that," Armanini says. "In the future, we may see *Reflux* changing distribution and packaging strategies. But we want to maintain a presence in the CD-ROM and computer channels, so we may stick with the same box just to reserve that shelf space, because if we go with thinner packaging, it may not get the presentation in a place like CompUSA or Fry's unless we get end caps. So we're working on doing something between end caps and a five-foot tenpack. We want to have our comic books hanging together as a group."

In addition to continuing with *Reflux*, Inverse recently signed a deal for another comic book series. "We're going to unveil a whole set of six new comic books at E3 this year," Armanini notes. "They'll also have video as the centerpiece of the product, but it's more superhero oriented. They're going to be less feature-ridden, they're going to be characters that you'll recognize, and they'll be at a significantly lower price point."

The Multitasking Staff

So how does Inverse Ink get these titles out the door on such a tight budget? "We try to appropriate people from related fields," Armanini tells us. "We get people we can retrain totally with our system. We have a pretty strict regimen. We have a manual that we put in front of everybody that shows people how to use tools the way we like to see them used. We try to keep the costs low by training our people to be really good users. That's how we're doing it. We just get better and better at what we do, and we keep the enthusiasm high. You have to have fun. That's the essence of it. Otherwise, you won't want to do it."

From a creative team of eight and 12 on the first two titles in the *Reflux* series, Inverse Ink has scaled down to teams of five or six. The new set of comic books may have teams as small as two.

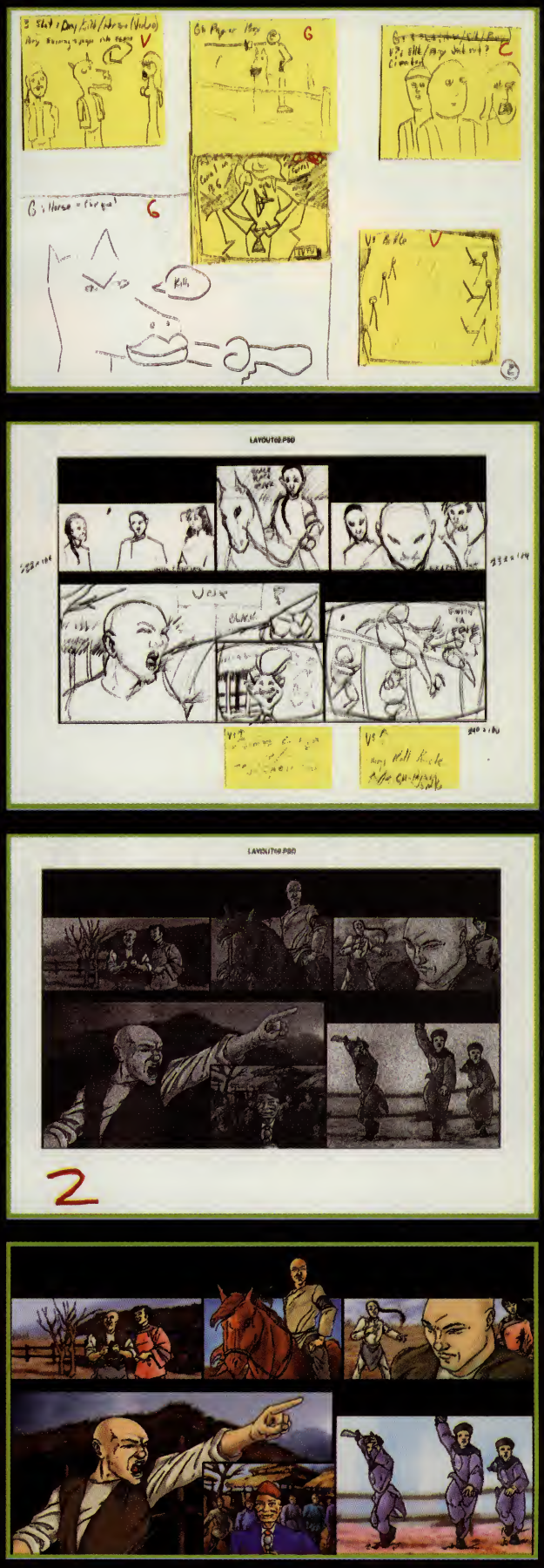
"That's at the artistic level," Armanini explains, "and then there's a small support group behind them. We have this Henry Ford model where the artists pass it off to the integrators who have very specific instructions and know exactly how to do it."

Integrators might be on several projects at once. That ups the team size a bit, but not much. "Really, everybody knows how to multitask. We try not to waste anything. Even our artists have a second task. Everybody has a primary skill set and a secondary skill set here," Armanini says.

Any other tricks? Armanini laughs, "We get them up every morning at 5 o'clock and we drill them to death. Jumping jacks, push-ups, sit-ups, we do it all. We just have a little army." Then he gets serious. "Our products are pretty much free-flowing and made on the fly. I think that keeps all of us on our feet. It's never routine, even though we work within a routine. That's it. I don't know. Is that a secret?

"I think it starts at the level of personnel. For instance, we did *Reflux: The Becoming* with Photoshop 2.1. No layers. That was awful to try to do hotspots with. But we did it, and we developed the skill to be able to work very efficiently. I think in that book we had 180 animations, and we did those in about six weeks or less. Just two or three of us. We learned to blaze through it. Then we got Photoshop 3.0. We were actually stunned, because right at the end of the book we switched over and we were all confused. We couldn't figure out how to work Photoshop anymore. It was alien to us. It's just about overcoming obstacles.

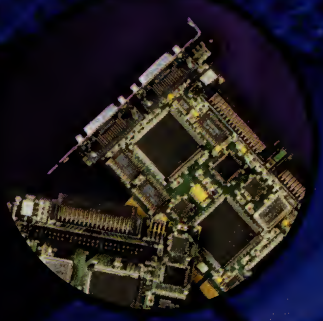
"Gosh, I probably sound like I was some sort of Nazi drill sergeant, but you adapt and overcome and make the best of it. And we go even faster now in Photoshop 3.0. Heck, I don't think it's much of a secret."



From storyboards and yellow sticky notes to the final version. The panels were created as traditional 2D pages and scanned in, and Photoshop was used to color the images.

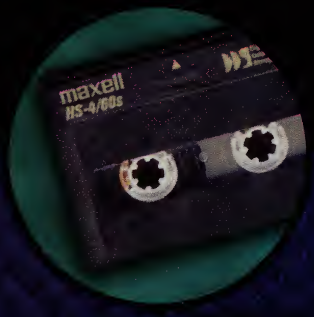
Storage

The Medium is The Message



Solutions

by Guy Wright



Back in the bad ol' days of computer programming when I first learned about languages, memory, and storage systems, there were four ways to save information. Hard copy, paper tape or punch cards, main memory, and platters (the forerunner of the hard disk drives found in just about every PC these days). ■ These days I have hard disks, floppies, tape backups, and a CD-Recordable drive on my PC. Even though many of the above can only be found in computer museums and closets, the current list of storage options is long, impressive, and somewhat confusing. What's out there? What's on the horizon? What makes

Storage Solutions

the most sense for multimedia developers these days? How does it all work together?

In the world of storage equipment, there have been many traditional ways to categorize storage media. However, with the advent of multimedia — video, animation, audio, and all the rest — the old yardsticks just don't apply anymore. For example, if we only talk about fixed vs. removable media, some products get cast in the wrong light. Hard disk drives are usually considered fixed media, but I know more and more developers who carry around external hard drives for showing their demos.

Beyond the actual media used to store data, there's the associated issue of connecting to the various devices. IDE, Enhanced IDE, SCSI, SCSI 2, Fast, Wide, Fast/Wide, and around the corner Fiber Cable, Master IDE, SSA, and Firewire — all of these solutions have advantages and disadvantages.

When thinking about storage solutions the most important questions are: What kind of data are you storing? How much will you need to store? How quickly do you need to get at it? Will you need to share or distribute the data with others? When it comes to offline storage solutions, how reliable are the various storage media? Finally, how much money are you willing to spend?

In a traditional development environment (if there is such a thing as traditional in this business), tasks are divided into categories like acquisition (gathering data), postproduction (where data is cleaned up or enhanced), programming, testing, and so forth. In many cases, different people are working on different tasks using different equipment and systems. You may have a team of people working on animation, another group working on video, another group putting together music and sound, and a team of programmers trying to thread all these elements together into a finished product. Each task requires different storage solutions.

In just about all these cases, the storage needs can be divided into three broad categories: online, transportable, and archival. Online storage is instantly accessible to the particular person or workstation. Transportable storage is how you move data from one person or place to another. Archival storage is where raw data or finished data gets placed for future use or backup in case of emergency. Each aspect of development can use all three categories of storage, but each type of operation has slightly different requirements.

Online storage

Online storage is where the data you are currently working on resides. This is usually RAM and a local hard disk drive, but it can include a network drive, RAID system, SyQuest or other removable media, MO drives, or floppies. Most of us have multiple online storage options available. Encoding MPEG video or sampling audio places heavy demands on a disk drive. Rendering frames of animation puts more demands on the processor and RAM side. Saving the latest rev of a program is a task that can be accomplished by even a lowly floppy disk (if the program isn't too large). With online storage, the primary issues are usually speed and capacity. Price and reliability usually take a back seat.

How Fast is Fast?

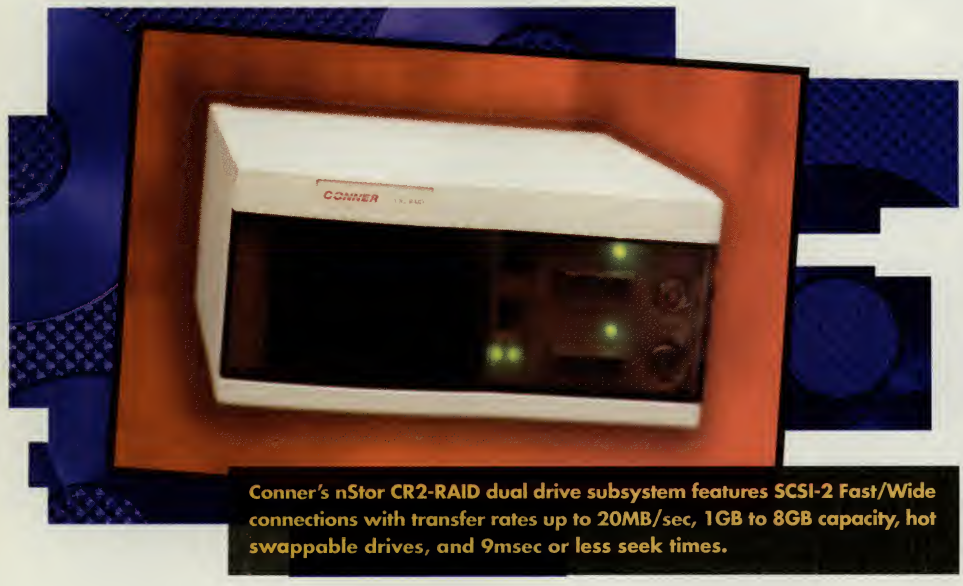
In some cases, your best storage option depends on how patient you are and how much you are willing to spend. If you don't mind waiting an hour or more, then tape systems or dozens of floppies may be fine. If you're less patient, then CD-R, removable disks, or MO drives might be the answer. If you think you might need the data quickly (by computer standards), then RAID or large hard disks can be very fast.

But there are some instances when you will need the data in real time (or even faster). For example, if you're recording to a 4x or 6x CD-R device (CD recorders, like CD drives, are rated 1x, 2x, etc., x being 150kB per second), then your old IDE 18ms, 1.5MB/sec. hard disk drive probably won't cut it.

A more common example of the need for faster-than-fast storage is during video and audio capture and digitization. We've all seen manufacturers of video digitization boards touting realtime video capture capabilities, but when you actually start testing these boards, it turns out that frames are being dropped. In some cases it isn't the board that's causing the problem — it's the hard disk (or the processor or bus or RAM or any of a dozen things). Normally, if you want to capture video, the frames are grabbed and temporarily stored to disk. Later, when there's more time, the capture system will compress the frames before storing them in their final form. If the hard disk system can't keep up during the initial capture phase, frames are lost and there isn't any way to get them back without going through the whole capture again. High-end audio capture and processing can fall victim to the same problem.

If you're capturing video, doing audio sampling, or burning CDs, speed is of the essence. But it isn't just bursts of speed. A hard drive has to maintain that speed during the entire capture or writing operation. Not only does your hard drive have to be fast, the interface you use must be able to support those extra fast transfer rates. (That is, it doesn't matter how fast your drive is if the bus only supports so much bandwidth.) Here's where you multimedia developers pay the price. Companies like Micropolis and Seagate have been producing over the past year or so what have been labeled AV drives. They're usually a few hundred dollars more expensive than their non-AV brothers even though capacities and throughput figures are roughly the same. So if the stats are the same, why would anyone pay extra for an AV-drive? The answer is a gotcha called thermal recalibration.

During disk access, just about all off-the-shelf hard disk drives pause for a fraction of a second every once in a while to cool down and readjust. This is called a thermal recalibration phase. Hard disk drives have been doing this for years. While no human would notice this pause, it can be just enough to cause dropped frames during video capture, skips in an audio track, or ruin a CD-R during the burn. These tasks require that data transfer be constant and uninterrupted. AV drives are designed to eliminate (or reduce) these hiccups. Some AV drives also reduce or eliminate the EDC and ECC (Error Detection Code and Error Correction Code) found in most drives. This is a tradeoff; less reliable reads and writes for pure speed. (Don't jump to the conclusion that an AV drive with no EDC/ECC is less reliable than a normal drive. In fact, most AV drives will outperform anything out there and do it reliably.)



Conner's nStor CR2-RAID dual drive subsystem features SCSI-2 Fast/Wide connections with transfer rates up to 20MB/sec, 1GB to 8GB capacity, hot swappable drives, and 9msec or less seek times.

StreamLogic's (which sold its Micropolis name and hard disk line) RAIDION fault-tolerant disk array. StreamLogic also manufactures the SpeedStack disk array optimized for audio/video editing. The new owners of Micropolis still manufacture the 2.1GB, 4.3GB and 9.1GB AV Gold series of hard drives.

Fortunately, a number of AV hard disk drives from companies such as Micropolis and Seagate (which just merged with Conner), do not have thermal recalibration phases, and fortunately for us multimedia developers who chew up hard disk space like it was candy, most very large capacity hard disk drives are also fairly fast. Fast is an 11ms access speed or faster (the lower the number, the faster the drive) with sustained transfer rates above 3MB/sec (see "Shopping for a Hard Drive" on page 35). This pretty much eliminates IDE drives and pushes you into EIDE at the minimum and SCSI-1 or SCSI-2 as a better option.

Realtime playback is another area that can really test the throughput of a system. Decoding a single stream of MPEG-1 from a CD-ROM shouldn't be a problem with the proper chipset or fast enough processor. But when you start talking about video on-demand systems, where multiple streams are being fed to multiple decoders, things start to get very complicated.

If you really need fast, fast storage, then nothing can beat RAM. Unfortunately RAM is easily the most expensive storage medium and the most volatile.

This brings up another point about storage systems and throughput. There are many things in a typical (or atypical) computer system that affect performance. I hear people say that they need a faster CD-ROM drive because the video on some game or other is choppy. I try to explain that the drive speed is only part of the equation. In many cases it isn't the drive at all. It's the video board that's dragging its feet. In other situations, it wouldn't matter if you had a 200x CD-ROM drive — the developer just didn't do a good job optimizing. Sometimes there isn't enough RAM to buffer the data adequately as it comes through. And, yes, in some cases it's the drive's fault. I've seen 2x CD-ROM drives perform better than 4x drives.

The reasons for this are many, but briefly, drive performance hinges on two main factors: sustained data transfer rate (how much data the drive can supply while reading contiguous blocks of information) and average access speed (the time between when the request is made and when data actually starts coming out). According to ISO 9660 specs, CD-ROMs must be able to supply data at a minimum of 150kB/sec, and even the cheapest, single-speed, 1x CD-ROM drive should be able to do this. However, this only applies to sustained transfer rates once the drive is actually sending data. It doesn't have anything to do with how long it takes the drive to process the request, figure out where the data is located, move the read heads to the proper track (called seek time), wait for the disc to spin around to the actual start of the data (called latency), read the header, make any adjustments in case it didn't actually find the right track the first time (called seek errors), and *then* start transferring data. CD-ROMs and hard disk drives both have to perform these tasks before data transfer can begin. CD-ROMs are notoriously slow when it comes to access speeds — sometimes measured in tenths of seconds! (Hard disk access times are usually given in milliseconds.) A hard disk drive used for video or audio digitizing should be able to perform all of these operations in less than 11ms (preferably between 8ms and 10ms). Unlike CD-ROMs, hard disk drives also must be able to write information, which involves a few extra steps such as figuring out where there is free space, chopping up the data (if there isn't a large enough contiguous empty block), generating the check-sum data (for error detection and correction), and updating the TOC (table of contents) directory. In RAID level 1 (see "RAID" on page 33) the data actually gets written twice, and even though it is usually written on two different drives, the write instruction has to be issued twice.

Another thing that can drastically slow down a hard disk drive is fragmentation. As files are written, erased, and moved around on a disk, the empty spaces between files become smaller and smaller. When new files are written, they get scattered around the disk to fill those gaps. Even though hard disk drive access speeds are measured in milliseconds, if your data is scattered all over a disk, causing the drive to do multiple seeks, even milliseconds can add up. The best way to avoid this is to use a defragmentation utility (like the one found in Norton Utilities) or reformat your hard drives every once in a while. If you have the disk space to spare, you can also leave a single drive or partition separate for those I/O intensive tasks, as long as you delete or move everything (and I do mean everything!) out of it just before use. Some developers take fragmentation so seriously that they defragment their drives every night, reformat the drives every week and re-install the operating system every two weeks!

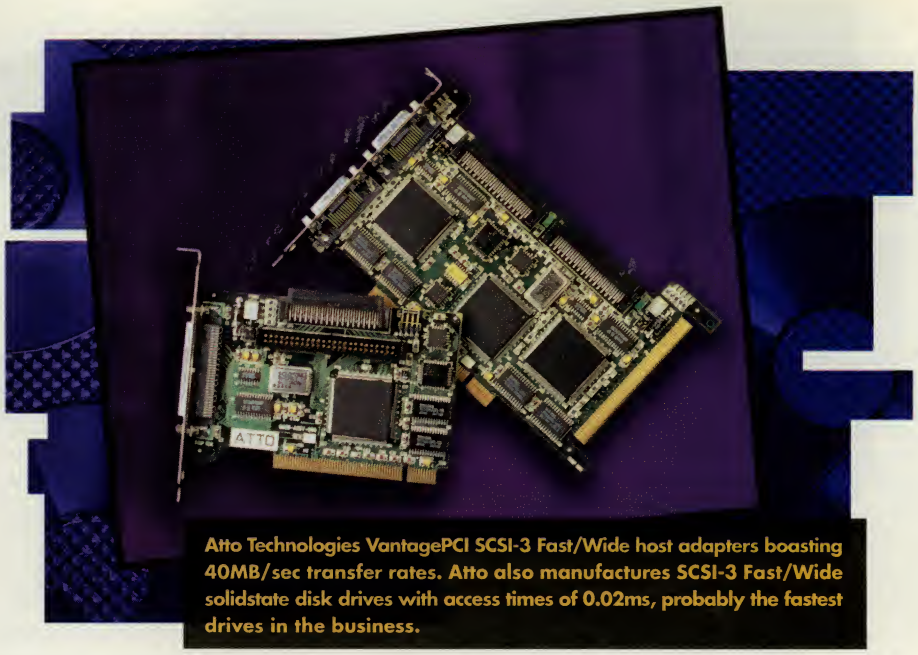
Beyond drive performance, the big bottleneck is the bus used to connect the drive to the rest of the system. There are nearly as many con-

Solidstate Disks:

When Really Fast Isn't Fast Enough

Quantum, Atto, and others have started shipping what could be the fastest disk drive technology yet, called solidstate. These drives are limited only by the speed of the connection to the computer. Using battery backed or trickle charged DRAM chips instead of spinning platters (the Atto system uses a combination of both), solidstate delivers the speed of RAM in a "hard disk" drive. This solution couldn't have been practical a few years ago, when RAM prices were high, but these days it can actually make sense. Using DRAM also eliminates things like latency, seeks, thermal recalibration, and all those time-consuming operations other drive technologies must undertake before actually sending data. Solidstate disks are still not cheap and they aren't the solution to every problem, but they point to a possible future where storage devices themselves no longer pose any speed limitation whatsoever and there are fewer and fewer moving parts to degrade performance.

Storage Solutions



Atto Technologies VantagePCI SCSI-3 Fast/Wide host adapters boasting 40MB/sec transfer rates. Atto also manufactures SCSI-3 Fast/Wide solidstate disk drives with access times of 0.02ms, probably the fastest drives in the business.

nection options as there are "standards" in the computer business (see "Connections," below). Again, here's where you multimedia developers get hit in the pocketbook. It always seems like the least expensive, most common peripherals are the ones you can't use — this is no less true when it comes to storage. IDE seems to be everywhere these days, but because of its limitations (drive capacities supported, number of drives you can connect on one bus, limited support for peripherals such as CD-ROM and, most important, speed) I'm afraid it just isn't up to snuff. EIDE is better but still can't keep pace. Even SCSI-1 is a little too limited. For a reasonable multimedia development system I would suggest SCSI-2, preferably SCSI-2 Fast, with 1GB or 2GB for the main online storage of program data, operating system, utilities, etc., and a second 1GB to 2GB AV drive specifically used for digitizing (or burning CD-Rs). The second drive should be formatted as one large partition (or the largest partition size that your OS will support). Oh yeah, don't use disk compression. No matter what the manufacturer claims, they always slow down your system.

Transportable Storage

If you're lucky enough to have a network (or unlucky enough, depending on your point of view) most of your data transportation problems can have simple drag and drop solutions. Need to get that video clip over to Fred? Just put it on the network. Need to share access to that RAID drive? Put it on the network. Need to back up everything at the end of the day? Put it on the network. It may not be fast, but it certainly beats typing.

But what about those instances when there isn't a network between your data and the person who needs it? That's when you need transportable storage. Earlier I mentioned people who carry around hard disk drives containing demos and other data. This is not always an optimum solution. Hard disk drives aren't very shock resistant, and you can't always be sure the system at the other end of the journey will have the right connections.

When it comes to transportable storage, the primary concerns are durability, compatibility, and capacity. Cost and speed take a back seat. Durability: How much punishment can the medium handle without losing data? Can you toss it in your briefcase or drop it? Can you mail it or put it through an airport X-Ray machine? Compatibility means we want to be able to get the data off the medium when it finally gets to its destination. Capacity, of course, refers to how

Connections

No matter what sort of storage device you have, it has to be connected to the computer somehow. Most peripheral manufactures offer a variety of options ranging from the slowest serial interface devices using the RS-232 port such as tape drives up to SCSI-2 Fast/Wide and beyond. Here is a brief description of the various options and their pros and cons.

IDE (Integrated Drive Electronics) or ATA (AT Attachment) is by far the most popular way to connect a disk drive to a PC, primarily because it's easy and cheap. However, you should be aware of some disadvantages. First, the original IDE specification has severe limitations like only supporting a maximum of two disk drives, no built-in support for other devices such as CD-ROMs, a maximum drive capacity of 528MB, and slow operation (between 2MB/sec and 3MB/sec). Also, IDE is not well suited to a multitasking environment, because it requires any write or read operation to be completed before accepting another. There are kluges and workarounds to some of these problems, but all of them will either cause slowdowns or headaches in the long run.

Fast IDE, designed for local bus PCI and VL-bus systems, offers increased performance but doesn't address the other problems.

ATA-2 or Enhanced IDE (EIDE) solves more of these problems, but not all. EIDE supports up to four dual-channel IDE devices (or more with multiple IDE connectors) including non-disk drive devices such as CD-ROMs and IDE tape systems. By extending the system BIOS through software, drives up to 8.4GB are supported. Finally, by using a few more programming tricks, data transfer rates up to 16.7MB/sec can be achieved (with projections up to 22.2MB/sec for future versions). Companies like Western Digital and Seagate are marketing fast ATA drives and pushing the barriers every day.

ATA-3, the next wave, will bring us to 20MB/sec to 32MB/sec using DMA mode 3 technology.

SCSI (Small Computer System Interface) is probably the option of choice for most multimedia developers because it does not have the restrictions that IDE has. On the downside, SCSI is more expensive because each device has to be SCSI smart. Another disadvantage to SCSI is that the cable length used to connect devices to the computer can't be any longer than three meters maximum using the standard single-ended cabling. It usually comes in short little two- and three-foot lengths. (You can get SCSI cables up to 25 meters using differential pair cabling, but this is a very high-end deal.) Another drawback to SCSI is

much data it'll hold.

By far the most common transportable storage medium is the floppy disk. Cheap, small, relatively durable, and broadly compatible. They don't hold very much and they are affected by magnetic fields, but they work.

CD-Recordable is even better. We'll consider this option in detail with respect to archival storage (below).

Next on the list are SyQuest cartridges. SyQuest seems to have become a standard in removable drives even though the cartridges are expensive and don't hold very much (by today's multimedia standards). Iomega and SyQuest have been engaging in a small war over the low-capacity removable market with prices dropping and capacities rising every day. SyQuest and other removable drive options are relatively durable (to a point) and relatively compatible from system to system.

Magneto Optical (MO) drives are more expensive than SyQuests, but they can hold a great deal more, are not as subject to magnetic fields, and MO cartridges are pretty durable (see "Optical Technologies" page 32). The biggest problems with MO drives are cost and compatibility. Not many people have MO drives, and the cartridges are not usually compatible between manufacturers.

We should mention flopticals, Bernoulli drives, Mini-Data Disks, PCMCIA devices, and other cartridge options. Unfortunately, most of these suffer from very high incompatibility and usually have a high price per megabyte, making them less practical than other options in most production and postproduction situations.

PCMCIA DEVICES

PCMCIA storage devices have been a godsend for portable computer users. There has been a rise in the number of desktop systems making use of the technology because of its plug-and-play capabilities and the fact that as standards go it's pretty standard. That is, you can share devices, peripherals, and storage between systems without a lot of hassles.

PCMCIA, as laptop users know, comes in Type I, II, and III. Type I cards are 3.3mm thick and use static RAM, Dynamic RAM (both battery backed), or EPROM technology to provide extra RAM and/or storage. The disadvantages are high cost, low capacity, and, in the case of EPROM, a limit to the number of times you can write to the chip. Type II cards are 5mm thick and have multiple peripheral support for things like modems and SCSI interface cards. Type III cards are 10.5mm thick, providing just enough height for some clever engineers to start manufacturing 1.8-inch hard disk drives with capacities around 80MB. You probably won't be seeing feature length MPEG movies on cards for a while, but sooner or later. . . .

Archival Storage

In archival situations, storage requirements shift to reliability above all and capacity and cost per megabyte secondarily. Compatibility and speed are rarely deciding factors, although they do play a part. You want to save as much of your precious data as safely and cheaply as possible.

Until a few years ago, the medium that satisfied two of our three main requirements (capacity and cost per megabyte) was unquestionably tape. Now CD-ROM is beginning to make a strong run at this monopoly. Primarily this is because of its durability compared to tape and its pretty good cost-per-megabyte figures.

I heard a story about a company that conscientiously backed up all their data to tape and stored the tapes in a data vault where they assumed things would be safe. At first, when they went to restore something, it was fine. But then they started noticing problems. Some tapes had been erased somehow. They suspected sabotage, but after a thorough investigation, it turned out that every few weeks, when the janitors polished the floor of the vault, the electric motor in the floor buffer generated a magnetic field strong enough to erase tapes that were near the floor. The lesson here is that sometimes security isn't all that secure.

Magnetic media is subject to magnetic fields, and in our electronic age magnetic fields are every-

that it can get a little confusing with controllers, software, SCSI IDs, and termination. Like IDE, SCSI comes in various flavors.

SCSI-1 (formerly just SCSI) can handle up to eight devices on the chain, is perfectly happy talking to anything that is SCSI smart, has no limitation on drive capacity, and offers transfer rates up to 5MB/sec.

The next step up, SCSI-2, comes in a few flavors of its own: Fast, Wide, and Fast/Wide. Fast increases the speeds up to 10MB/sec. Wide increases the bus width to 16 or 32 bits using a second cable to increase the number of devices to 16 or 32. Fast/Wide offers the best of both with 20MB/sec up to 40MB/sec transfer rates with dozens of devices.

SCSI-3 is right around the corner. Examples include Atto Technology's SiliconDisk II (which uses DRAM for some of the drive's storage providing very, very fast access); Quantum's Fireball 640, Empire series, Grand Prix series, and Atlas series; Seagate's Barracuda family. There is some grumbling that some of these devices are not really SCSI-3, but the drive manufacturers point out that these drives do incorporate some of the proposed SCSI-3 features, such as fiber channel interface (boasting transfer rates of 100MB/sec.!). You will also run across drives that are simply SCSI-2 Fast being called SCSI-3. Does it really matter? Probably not, but read the specs before purchasing.

FireWire, or as the engineers fondly call it IEEE 1394, is sometimes referred to as serial SCSI. As that alias implies, FireWire is a serial solution with a lot more bang for the buck. Speeds approaching 100MB/sec, 200MB/sec, and even 400MB/sec have been claimed. FireWire also boasts support of up to 63 devices in one chain and no cable length limitations. Sony, Matsushita, Microsoft, Texas Instruments, Adaptec, Cirrus Logic, Conner, Western Digital, and Apple have already jumped on the FireWire bandwagon. Skipstone is already shipping product. FireWire seems to be the answer to everybody's throughput wish list. Will it live up to expectations? Probably, sooner or later.

SSA (Serial Storage Architecture) is yet another high-speed data conduit being promoted by IBM, Adaptec, Conner, and Micropolis. It doesn't suffer from the cable length restrictions of SCSI and can support more than 80MB/sec transfer rates using multiple 20MB/sec links. Future versions should be able to support transfer rates of more than 160MB/sec. SSA connections are fault tolerant and have no trouble with hot plugging (i.e., connecting devices while power flows through the bus).

where. Those cute little $40 speakers you bought at Radio Shack generate magnetic fields. Screwdrivers are sometimes magnetized. Anything with an electric motor can generate a magnetic field.

All forms of storage media are also subject to the bane of all living things: time. They just plain get old and eventually die. Use and re-use a tape or disk and eventually it will wear out. Even if you don't touch it, the iron-oxide (or whatever material is used to maintain the magnetic pluses and minuses) will flake off the plastic or metal substrate. Heat, humidity, dust, and even gravity sooner or later will cause a medium to fail. Tape backup solutions are subject to the same problems that video tapes are.

But, as the FAA (Federal Aviation Association) will tell you, the number-one enemy of storage systems is pilot error. A tape gets mislabeled, overwritten, or left in the sun. Someone uses a ballpoint pen to write on a floppy disk. A hard disk gets dropped or bounced one too many times. Coffee gets spilled. Dogs get hungry. #-*~% happens.

Currently, about the safest long-term storage solution is CD-R. If you thought you couldn't afford CD-R in your shop, you might want to take another look. The cost for recorders has plummeted in the past year. (The Yamaha CD 100 4x is under $2,500, and HP and Pinnacle units go for under $1,000.) The software has also gotten a lot more sophisticated and easier to use at the same time. The blank discs (usually called gold discs) are fairly inexpensive (now around $7), hold about 650MB, are read-only, and are relatively durable. CDs are not subject to magnetic fields and can't be accidentally erased. Another advantage is that a disc recorded according to ISO 9660 specifications can be read by just about any CD-ROM drive attached to any computer.

While slow compared to a hard disk drive, CD-ROM is random-access and doesn't require special compression/decompression software. While I wouldn't recommend using one as a Frisbee (they don't fly very well anyway), a gold disc is remarkably sturdy.

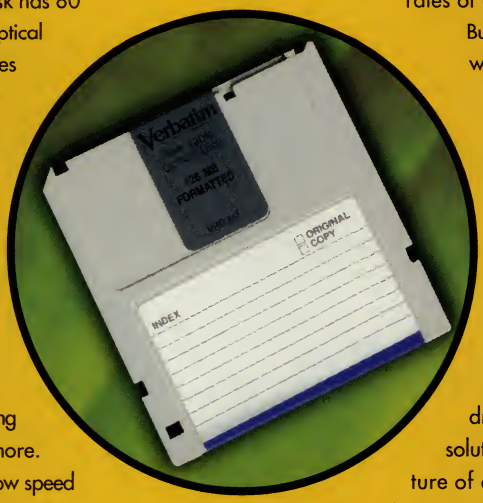
No one is absolutely sure how long a CD-R disc will hold its data, but based on recent testing, the best guess is between 150 and 300 years (about three times longer than a commercially duplicated CD). While gold discs do use a layer of heat-sensitive dye (most manufacturers recommend that you don't leave them in the sun or on the radiator), tests indicate that if you left one on a table exposed to sunlight through a window, the dye would start to break down in 30 to 50 years. Note that sunlight through a window is a relatively modest temperature. The discs are, after all, made of plastic, dye, and gold, so a car dashboard is not a good place to store them. The data probably will be okay, but if the disc warps, you won't be able to get it into a CD drive.

Next in terms of durability is probably MO and removable-media hard disk devices. Setting

Optical Technologies

At the core of all optical technology is a low-powered laser. While CD-ROM and laserdisc players are purely optical, some devices use a combination of optics and magnetic technology.

Flopticals utilize an optical tracking system to position the magnetic read heads on the magnetic media more accurately. This results in much higher accuracy in head positioning, which results in more tracks per inch on the disk. Where a traditional 1.4MB floppy disk has 80 tracks per side with about 135 tracks per inch, a floptical has nearly 1,000 tracks per inch yielding capacities above 20MB on a single disk. While this system does nothing to enhance transfer rates (floptical is about four times slower than a SyQuest), it does reduce seek times. Floptical's magnetic head system will wear out sooner or later.



Magneto Optical (MO) drives also use a combination of optical and magnetic technologies. Magnetic fields are used to write data while lasers are used for reading. The advantages of MO are that the cartridges are much less susceptible to shock or magnetic fields than hard disk drives and, according to Sony, the cartridges should last 100 years or more.

In the past, the biggest drawbacks to MO were low speed and high cost compared to just about any other form of storage. Recently companies like Apex, Sony, Fujitsu, IBM, Maxoptix, Torray, and NEC have been bringing prices down and capacities and speeds up. You can still expect to pay between $1,500 and $2,000 for a 1.3GB drive and about $2,500 for a 2.6GB drive. Optical jukeboxes start in the $5,000 ballpark.

Of course, once you have the drive, the cost per megabyte drops dramatically. A quick survey of prices shows that 128MB cartridges average about $25 each, 230MB cartridges about $30, 650MB cartridges about $80, and 1.2GB cartridges about $90.

Speed is still something of a problem, however, with even the fastest drives still poking along at less than 4MB/sec during reads. While this is three times faster than a single speed CD-ROM, it is a far cry from the 40MB/sec speeds offered by SCSI-2 devices. The exception to all this is Pinnacle Micro's Apex and Orray's Optical Hard Disk drives, which boast transfer rates of up to 8MB/sec.

But MO outshines just about every other storage system when you need really, really vast amounts of storage. If you need terabytes then MO jukeboxes are definitely the way to go. You get the same transfer rates and pay a significant time penalty while cartridges are changed, but if you need the storage space, it's there. Pinnacle Micro's Grand Teton provides up to 1.3 terabytes and fits neatly in any good-sized walk-in closet.

Phase Change Dual (PD) drives are the next generation in optical technology. Matsushita and Panasonic recently announced this type of optical drive that takes the M out of MO. It's a purely optical solution that uses a laser to change the crystalline structure of a resin-coated platter.

This is one of the first truly re-writable CD-ROM technologies to come along. Not only can you store 650MB on a disc, but it should last for decades. The drives should also be compatible with existing CD-ROM drivers and operating systems. Another advantage to the system is that the drive doubles as a quad-speed CD-ROM reader. Of course, PD shares one of the problems inherent with CD-ROM: low speed. PD is precisely the same speed as a 4x drive, which translates into 8.7MB/sec. Faster than a traditional MO drive, but hardly FireWire.

RAID

At the time it was first developed, RAID (Redundant Array of Inexpensive Disk Drives) was considered a good way to store data with instant access (usually over a network). Systems were designed based on two assumptions: hard drives were not very reliable (and in the old days they weren't), and most data comes in small chunks. To solve the first problem, RAID systems make multiple copies of the data on more than one drive. If one drive in the array goes down, the information can be retrieved from another (that's where the redundant comes in). This makes sense in a corporate environment where the cost of data loss is a very great deal higher than the price of a few disk drives. As for the second premise, in a corporate environment, most files stored on a network drive are spreadsheets, databases, and word processing documents. So, again, RAID makes perfect sense.

This scheme starts to break down when you want to do video, audio, or animation. This type of data comes in very large chunks and relies heavily on constant, uninterrupted write and read rates. Most RAID systems are good at short, fast bursts but, like a cheetah, they can't supply sustained fast access. Also, because of the redundancy, they are not very cost effective. (A 10GB RAID system may only be able to store 5GB of data depending on the security level technique employed.)

To understand RAID, you should know three concepts: striping, mirroring, and parity. Combinations of these elements comprise the various RAID levels. A traditional hard disk drive contains a single metal disk coated with a magnetizable substance such as iron oxide. The armature passes the read/write head over the surface and switches the polarity or reads the polarity. The data is written in one contiguous pass unless fragmentation causes it to be scattered all over the disk. In a RAID system, where there are multiple drives and therefore multiple platters, you could write the data in the same fashion or, with striping, you could write some of the data on one drive and some on another. More than one head can be working at the same time, theoretically, so, with two platters you could double your throughput. In practical terms, a certain amount of overhead is consumed dividing the data and issuing the instructions. Nonetheless, RAID is faster than a single disk system.

Mirroring is simply making one for one copies of the data on multiple disks. An alternative to mirroring is parity checking. Here's an oversimplified explanation: The system adds up all the bytes in a chunk of data and appends the total to the end. Then, during data transfer, it adds up the bytes of data and compares the new sum to the number at the end. If there is a discrepancy, then something went wrong and it tries again. More accurately put, the parity technique processes chunks of data through an algorithm that generates a set of values, which are saved. If any of the data is corrupted, usually it can be re-created from the parity values. It's a little bit like storing a highly compressed version of the data rather than a complete copy.

RAID Levels

RAID 0 is the simplest and fastest form of RAID and uses striping. No mirroring, no parity, but also no redundancy. In most situations, RAID 0 is faster than a single hard disk drive, but if one of the platters fails, you lose your data.

RAID 1 uses striping and mirroring. It yields top speeds in reading (when there are no problems), slower writes (because the data gets written twice), very good protection against data loss. This is the most expensive form of RAID since 10GB of disk space equals 5GB of usable storage.

RAID 2 uses striping at the bit level and stores parity information on one or more disks. It's not widely used these days because it's considered slow and expensive.

RAID 3 uses striping at the byte level and stores parity information on a dedicated platter. This results in fast reads, more efficient use of the array, and good data security. Writes are slower because of the multiple commands necessary to write the data and the parity information. (Note: what most RAID manufacturers call RAID 3 is often RAID 4 because it is slightly faster, but it doesn't really make that much difference.)

RAID 4 is pretty much the same as RAID 3 except the striping is done on larger chunks of data, making it slightly faster during reads.

RAID 5 uses striping and parity techniques (similar to 3 and 4). However, the parity information is distributed throughout the array rather than being relegated to a fixed location on a single platter. This makes it a bit faster than RAID 3 and 4, but it still suffers from the write delays not found in RAID 0.

Which RAID is right for you? If you want pure speed and are willing to risk losing data if one of the platters fails, then RAID 0 is definitely the answer. If you still want speed, but are a wealthy paranoid type, then RAID 1 is probably for you, providing lots of security and speed at twice the cost. If you can live with slower writes and want security then RAID 3, 4, or 5 is probably the answer.

The Micropolis Microdisk and FWB's Hammer series address the needs of the new generation multimedia developers through optimization for both large and small data transfer situations. Improvements have been made to RAID 5 (even talks about a RAID 7), and with the advent of parity caching (where the parity data is stored temporarily in RAM) RAID systems are becoming more and more attractive to multimedia developers.

aside cost and compatibility issues, MO cartridges are not nearly as sensitive to magnetic fields as tape or floppies. They're closer to hard disk drives in this regard. Like CD-ROM, they are random-access, and in some fields, like SyQuest cartridges in the print industry, they have become fairly common.

MO does have its limitations, however, primarily cost and compatibility. MO technology has made great strides in terms of capacity and price, but it's still expensive on a cost per megabyte basis, and cartridges are not usually compatible between brands. These days, when a 500MB hard disk drive sells for about $250 and a blank CD-R gold disc holding 650MB costs about $7, one wonders about the future of MO. 650MB MO cartridges go for about $100. (Come to think of it, a SyQuest cartridge costs close to $80 for only 200MB!) Granted this compares apples to oranges, but these fruit are getting more similar every day. (Within a year or two, quad-density, 2.6GB re-writable CDs will be available.)

Tape still makes sense for long-term offline storage (see "Unraveling Tape," page 36). Tapes are cheap (2GB for about $10), compact, and, if you exercise a little care in storing them, durable. It does require some sort of TAR (Tape Archive and Retrieval) software, but this is available from dozens of companies. Tape is not random-access and backing up or restoring data usually is a very time-consuming process (it can take literally hours to back up a few hundred MB depending on the device and the software you are using). That is why network backups are done at night after all the users have gone home.

If you have all the time in the world and cost is a major factor, then you might check out the $250 tape systems that have flooded the PC mar-

ket recently. If you can afford to spend a little more, then Quick-80, Colorado Trackers, or other higher-end tape systems will probably be more satisfying to use.

And don't forget the good old floppy disk. It's fairly cheap (although you get what you pay for), fairly reliable, nearly universal, and you get slow but random access (unless you use a backup or compression program). Floppies are subject to magnetic fields, dust, heat, wear and tear, and other problems, but most of us know about these drawbacks and continue to store data on floppies. Not a bad choice if you're archiving very small files.

What You Store Might Influence What You Store It On

If you're storing video, by far the most efficient way to store it is on video tape. Digital video is great, but hardly an efficient way to store movies. On the whole, analog systems can store much,

Resources

Adaptec, 691 South Milpitas Blvd., Milpitas, CA 95035; vox 800.959.7274, 408.945.8600; fax 408.262.2533; Web http://www.adaptec.com; BBS 408.945.7727.
Reader Service #121

Apple, One Infinite Loop, Cupertino, CA 95014; vox 408.996.1010.
Reader Service #122

Atto, 40 Hazelwood Dr., Ste. 106, Amherst, NY 14228; vox 716.691.1999; fax 716.691.9353.
Reader Service #123

Central Data, 1602 Newtown Dr., Champaign, IL 61821; vox 800.482.0315, 217.359.8010; fax 217.359.6904; Web http://www.cd.com; FTP ftp.cd.com.
Reader Service #124

Cirrus Logic, 3100 W. Warren Ave., Fremont, CA 94538; vox 510.623.8300; fax 510.226.2240; Web http://www.cirrus.com.
Reader Service #125

Conner (Storage Systems Group), 450 Technology Park Dr., Lake Mary, FL 32746; vox 407.263.3500; fax 407.263.3555.
Reader Service #126

Fujitsu, 2904 Orchard Pkwy., San Jose, CA 95134-2009; vox 800.626.4686, 408.432.6333; fax back info 408.428.0456; BBS 408.944.9899.
Reader Service #127

FWB, 1555 Adams Dr., Menlo Park, CA 94025; vox 415.325.4392; fax 415.833.4657; email info@fwb.com; Web http://www.fwb.com.
Reader Service #128

Hewlett-Packard, 11413 Chinden Blvd., MS 337, Boise, ID 83714; vox 800.752.0900, 208.323.2332; fax 208.323.3991.
Reader Service #129

IBM, 5600 Cottle Rd., San Jose, CA 95193; vox 800.765.4426, 408.284.6039.
Reader Service #130

Iomega,1821 W. Iomega Way, Roy, UT 84067; vox 801.778.1000; fax 801.778.3158; Web http://www.iomega.com.
Reader Service #131

Matsushita/Panasonic, 2 Panasonic Way, Secaucus, NJ 07094; vox 201.348.7000.
Reader Service #132

Maxopolis, 2520 Junction Ave., San Jose, CA 95134; vox 800.848.3092, 408.954.9700; fax 408.954.9711.
Reader Service #133

Megadrive, 489 S. Robertson Blvd., Beverly Hills, CA 90211; vox 310.247.0006; fax 310.247.8118.
Reader Service #134

NEC, 1414 Massachusetts Ave., Boxborough, MA 01719-2298; vox 800.632.4636, 508.264.8000; fax 508.264.8673.
Reader Service #135

Panasonic (see Matsushita)

Pinnacle Micro, 19 Technology Dr., Irvine, CA 92718; vox 800.553.7070, 714.789.3000; fax 714.789.3150; Web http://www.pinnaclemicro.com.
Reader Service #136

Quantum, 500 McCarthy Blvd., Milpitas, CA 95035; vox 800.669.7587, 408.894.4000; fax 408.894.3218; Web http://www.quantum.com.
Reader Service #137

Seagate/Conner, 930 Disc Dr., Scotts Valley, CA 95066-4544; vox 408.438.8222; fax 408.438.8137; Web http://www.seagate.com; BBS 408.438.8771.
Reader Service #138

Skipstone, 3925 West Braker Ln., Ste. 425, Austin, TX 78759; vox 512.305.0200; fax 512.305.0212; Web http://skipstone.com.
Reader Service #139

Sony, 3300 Zanker Rd., San Jose, CA 95134; vox 800.352.7669, 408.432.0190; fax 408.432.0253.
Reader Service #140

StreamLogic (Micropolis), 21211 Nordhoff St., Chatsworth, CA 91311; vox 800.395.3748, 818.709.3300; fax 818.701.2809.
Reader Service #141

SyQuest, 47071 Bayside Pkwy., Fremont, CA 94538; vox 800.245.2278, 510.226.4000; fax 510.226.4100; Web http://www.syquest.com; BBS 510.656.0473.
Reader Service #142

Symbios Logic, 2001 Danfield Ct., Fort Collins, CO 80525-2905; vox 970.223.5100; fax 970.226.9566; Web http://www.symbio.com.
Reader Service #143

Texas Instruments, Box 655012, MS 57, Dallas, TX 75265; vox 800.336.5236, 214.995.6611; Web http://www.ti.com.
Reader Service #144

Toray, 1875 S. Grant St., Ste. 720, San Mateo, CA 94402; vox 415.341.7152; fax 415.341.0845; Web http://www.toray.com.
Reader Service #145

Western Digital, 2445 McCabe Way, Irvine, CA 92714; vox 800.832.4778, 714.863.0102; fax 714.863.1656; Web http://www.wdc.com; BBS 714.753.1234.
Reader Service #146

much more information than digital systems. The tradeoff is that analog systems are a bit sloppy and tend to lose information here and there. This is unforgivable in the world of computers, but for raw video it usually doesn't matter. So what if one or two pixels on a video frame get lost? At 30 frames per second no one will ever see it. You can make high quality dubs or safety masters to work from if you're worried about losing information.

If you are really worried about maintaining the absolutely highest quality, then be prepared to spend a lot of time and money. Digitize each frame at 24 bits and save each one individually; don't use any lossy compression like JPEG or MPEG. This probably won't help you much if you are creating a video on-demand system or need to store the data for a century or more (video and audio tape is subject to the same deterioration problems that most other media is).

Computer animation is usually created at a lower frame rate than video. Also, unlike video, raw animation doesn't have a lot of visual noise. Areas of black are usually a solid, consistent black. White is white, etc. This is also true of rendered images but not scanned or deep-pixel type images. This means that RLE (Run Length Encoding) compression schemes like pkzip, which are usually lossless, will do a good job. Video has lots of visual noise and inconsistencies from frame to frame. A black screen actually has hundreds of shades and colors that change from pixel to pixel, frame to frame. (See "Acronymadness: The IA Guide to Graphics File Formats" in the May/June '95 issue of *InterActivity* for a detailed discussion of compression algorithms used with various file formats and their appropriate uses.)

When it comes to graphics, animations, video, and audio, storage requirements quickly shoot through the roof. An hour of MPEG-1 video or 74 minutes of Red Book audio consumes about 650MB (enough to fit neatly on a single CD). MPEG-2 consumes roughly four times the amount of space as MPEG-1 (and requires four times the bandwidth). A single 24-bit image can chew up 10MB or more. Even computer generated animations are storage hogs. Digitized analog source materials (the original uncompressed frames and high-res scans) take the most space.

Unfortunately, this is precisely the material you should be archiving, probably more important than whatever format you end up with. Too often it's the first thing to be discarded when hard disk space runs short. Later, if you need to convert to a higher resolution or you find that some of your digitized video doesn't look right, it'll be much easier to restore the original data than re-scan, re-capture, or re-shoot.

Rapid technological evolution poses its own problem for data storage: obsolescence. I have data stored on tapes that's perfectly secure except for the fact that I no longer use that type

Shopping for a Hard Disk Drive

You might think that since you're developing multimedia, you automatically need a high-performance AV drive. This isn't necessarily the case. It really depends upon what you plan to use the drive for. According to Kris Bakke, product manager at Seagate, you may not need an AV drive, unless you're involved with fairly demanding video and audio processing or building video servers. "Sure, I'd like to sell someone the more expensive model, but in 70% of the cases our standard drives are fast enough," he says. "When you get into high-end digital video systems for editing and ad insertion, where you need guaranteed throughput and every frame counts, then AV drives are a necessity."

If you're doing any kind of video or audio capture, you need a fast drive and a fast interface. Playback, however, is not quite as demanding. Single-stream playback can be handled by just about any storage media (MPEG-1 was designed to play off a single-speed CD with its less than impressive 150kB/sec transfer rate.)

When you start getting into MPEG-2 or multiple streams, then things begin to get complicated. Not only does the drive system (usually RAID or MO jukebox) have to deliver a lot of data very quickly, the software algorithms used to segment data have to be fairly sophisticated.

When shopping for a hard disk drive (or just about any other kind of drive), it's easy to get sidetracked by some of the numbers tossed around. Here's a quick list of things that influence how fast a drive really is:

Transfer rate: Transfer rate is probably your best yardstick for measuring a drive's performance. This is usually given in megabytes or megabits per second (very important to know which). This should be the average sustained transfer rate, but some manufacturers list their burst rate (how quickly data moves out *after* it has been stored in a cache). Depending on your application, you should be aware that sometimes transfer rates are listed only for reads, and that writing usually is slower. In many cases, the transfer rate is limited to the type of connection you use. Even if a drive boasts an 18MB/sec transfer rate, you'll only see 3MB/sec if it's connected via ATA, or 5MB/sec if it's connected via traditional SCSI.

Access time: This is the elapsed time between a request for data and when the data is delivered. Lower access time means a faster drive.

Seek time: The time it takes the drive to find the data you have requested. Usually this is listed as average seek time, but sometimes you'll see figures for worst-case or track-to-track. (By the way, CD-ROM seek times can be atrocious.)

Latency: This is the average time it takes for data to come under the read head once its track has been found. This is a direct function of the drive's RPM.

RPM: Revolutions per minute, the speed at which the platter is spinning.

Command overhead: The time required to process a request.

RAM cache: A temporary holding area where most frequently accessed data is stored. A lot of companies tout various algorithms for determining exactly what data should be temporarily stored here. Bigger caches and better algorithms can speed up a drive in some cases, but can mean next to nothing during large block reads.

Number of platters: More platters usually means a faster drive, if striping is used. (This is why 4GB drives are faster than 512kB drives.)

Thermal recalibration: A momentary slowdown of the drive to dissipate heat and make fine adjustments to the head position. A bad thing when you need uninterrupted data transfers, for example when burning a CD-R. Unfortunately, very few drive manufacturers list this in their specs unless it's absent.

Unfortunately, most drive manufacturers list only best-case figures for their drives and fail to mention that writing is almost never as fast as reading. In the case of some removable media devices, which usually are slow compared to fixed drives, a common trick is to list storage capacities and transfer rates based on compressed data.

If you plan to do a lot of media capture or CD burning and you can afford the extra hundred or more dollars for an AV drive rather than a less expensive model with the same specs, you won't be disappointed. For now SCSI (preferably SCSI-2) is definitely the way to go. Bite the bullet and get a good controller (the cheap SCSI controllers just aren't worth the hassle) and expect to pay more for cables and terminators. Adaptec is still the ruler in SCSI boards, but you can get high-end SCSI adapters from Central Data, and mid- to high-end SCSI product from Symbios Logic, and Western Digital. If money is a problem, then EIDE might keep you going for a while. In all cases, read through the specs carefully and if in doubt, call the manufacturer and ask.

Storage Solutions

Megadrive's eight-slot Enterprise 8 Storage system can accommodate up to eight 3.5" drives (ranging from 535MB to 4.2GB each), or four 5.25" 9GB drives, providing up to 36GB of storage with 20 MB/sec transfer rates (the units can be daisy chained if you need more, and advanced thermal recalibration technolgy makes these ideal for AV). You can also include tape backup drives or optical drives, and there is a rack mount version.

of computer, probably couldn't connect that particular tape drive to any other system, and even if I could, I am positive the software wouldn't work. Many TAR packages use data compression schemes that aren't as universal as one might think. It's a lot like locking your keys in your car. They're safe all right, you just can't get at them.

This can be a major problem if you have lots of stored data. I don't know a single development house that isn't constantly upgrading their equipment, adding newer, better, faster machines. Transferring gigabytes or terabytes from one archival system to another is one of those dreadfully boring tasks that most of us would rather put off to another day when we have more time. Unfortunately, that day never arrives. My advice is to bite the bullet and set aside a day (or two if necessary). Get a good book and just do it. The reward is the feeling that you can delete files without agonizing over each "are you sure?" message.

Cost: The Final Question

How much you need to spend may depend on how valuable you think your data is. How much would it cost you to replace it if it were destroyed? Can you trade time for dollars? There are very inexpensive tape drives on the market, but they usually take a lot of time to use. There are inexpensive disk drives but if you're doing video or burning CD-Rs, the extra money for a faster drive would be well spent. At the other extreme are solidstate disk drives (see "Solidstate Disks," page 29). Faster than fast but cost a fortune.

Traditionally, you can evaluate storage systems on a cost per megabyte (CPM), but keep in mind that a better CPM doesn't necessarily mean a device will work best in your particular situation. A quick CPM breakdown of various media, ranked best to worst looks something like this (figures are approximate):

$ .0005	Video and audio tape (or just about any analog storage medium)
$ .001	CD-ROM
$ .005	Data tape
$ .01	CD-Recordable
$ .40	Floppy diskette
$ .50	Hard disk
$ .75	SyQuest or MO cartridge
$ 25.00	RAM
$ 30.00	ROM

Like all technology, data storage is changing rapidly. On the horizon we have quad-density CD-ROMs, re-writable mini-CDs, ever cheaper hard disk drives, and very volatile RAM and ROM prices. Perhaps data crystals or organic storage devices will become viable before long, and we've only briefly touched on compression schemes, which stretch your storage dollar and keep getting better every day.

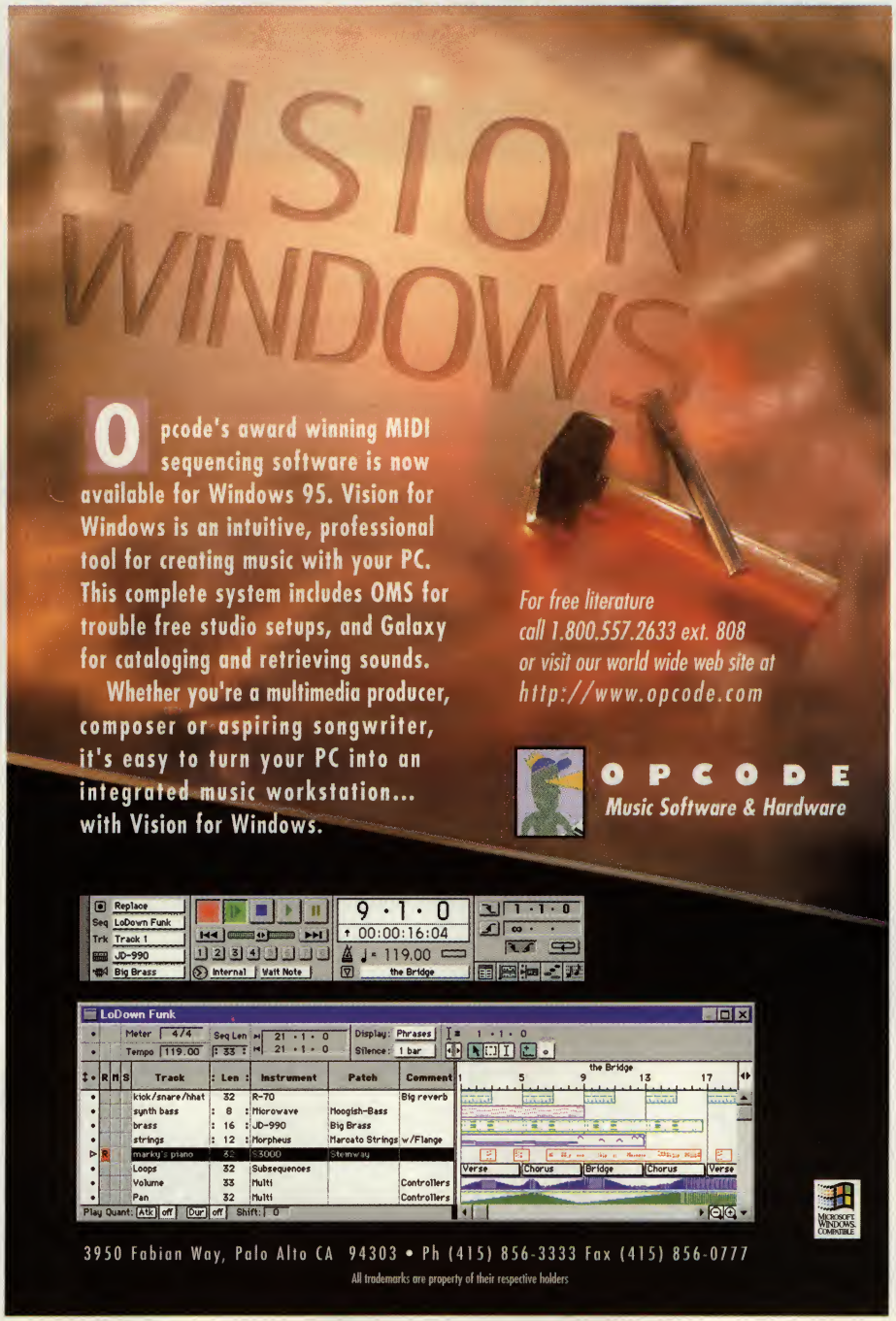
There are lots of ways to store information and lots of questions to answer before you rush out and buy. Your solution will probably contain a number of these technologies, making use of their strengths to perform different storage functions. Hard disks for fast access, medium cost, and durability; floppies for day-to-day small-volume, relatively safe storage; RAM for very fast yet very temporary storage; and perhaps tape or CD-R for long term, durable, and inexpensive storage. I have managed to avoid the Number One storage cliché so far, but I don't think I can close without saying it at least once. Better safe than sorry.

Unraveling Tape

Tape drive systems come in two formats: Linear systems, such as the ubiquitous QIC (Quarter Inch Cartridge), and Helical Scan systems. QIC drives are pretty much like audio tape decks; the read/write heads record data as the tape passes by. Helical Scan drives are closer to VCRs, where the heads spin at an angle while the tape moves past, writing data in long diagonal strips. Consequently, QIC drives (available from companies such as Colorado, Wangtek, Iomega, and Archive) are not quite as efficient in tape use. QIC cartridge capacities range from 150MB up to 2GB. Helical scan drives (made by companies like Archive, Sony, Exabyte, HP, IBM, and Wangdat) usually come in sizes from 1.3GB up to 5GB and beyond.

While magnetic tape of any kind eventually will wear out, warp, or shrink, tape is considered a good archival medium. It is cheap (QIC cartridges usually go for around $20; 8mm and 4mm tapes about $10). It is slow (transfer speeds are usually in the MB/minute range). Incompatibility between systems and software abounds. Tip: When shopping for tape systems, note whether the capacity is listed straight or compressed. Some manufacturers feature compression hardware in the drive itself while others rely on the backup software to do the compression. Also note that formatting a tape and writing a few hundred megs can take literally hours!

Tape drives are notorious for settling into their own unique tensioning (how much tension is applied to the tape as it passes over the read/write heads). Data recorded on one drive may not be restorable from another. If the drive you are using is still settling, you may not even be able to read tapes you recorded a few months ago. This is particularly true with inexpensive tape drives, which have a nasty habit of drifting a tiny bit every time you use them. With any tape drive, it is a good idea to check older archives every once in a while. If you start finding read problems, it's time to restore and resave everything.



READER SERVICE NO. 11

FOUR OF A KIND

Never bet against a sure thing

When it comes to making the most dynamic presentations, don't put your money on anything less than a proven winner. The complete line of projection systems from ASK have won consumer approval for performance, durability and value. So don't be bluffed by the competition, let ASK be your ace in the hole!

IMPACTWSX ♠

The Impact™WSX LCD projection panel from ASK can handle everything from Macs and PC's to Sun, HP, and SGI. With full 24-bit color processing and our innovative BatMouse™ wireless mouse control, the WSX offers both superior image quality and superb ease of use. Displays all resolutions up to 1280 x 1024. All cables and hard attache case included.

♥ IMPRESSION 960

The Impression 960 is the first HIGH RESOLUTION data/video projector that can display both Macs, PC's and workstations from Sun, HP, SGI, and IBM. ASK's RESmaster II™ and Batmouse™ technologies allow superb ease of use and resolutions up to 1280 x 1024. All cables and padded carrying case included.

IMPACT 24 ♣

The Impact™24 LCD projection panel is designed to reproduce high-quality color computer and video images. Macintosh and PC compatible with integrated video interface, built-in speaker and convenient wireless BatMouse™. Featuring an outstanding palette of 16.7 million colors, and resolutions up to 800 x 600, the Impact 24 delivers all you could expect from a multimedia panel. All cables and hard attache case included.

♦ IMPRESSION 750

True multimedia projection starts with the ASK Impression™750, the lightest LCD projector in it's class at 17 pounds. The 750 displays resolutions up to 800 x 600, and comes with on-board video, stereo speakers, and wireless mouse control. Plug in your computer, VCR, or camcorder and enjoy stunning images in 16.7 million colors! All cables and padded carrying case included.

ASK

Call to arrange for a free demonstration. 1-800-275-5231

READER SERVICE NO. 12

ZOMBIES, MARKET SHARE, and the STATE of the DELIVERY PLATFORM

Where it's at and Where it's Going!

Written by
OMID RAHMAT

"I need zombies, the kind that like to eat brains and stuff like in that movie, what's its name?" The vice president of Entertainment Software at Really Big Games looked at his unknowing assistants for help. "All those years at Harvard and you know nothing," he spat at the poor interns. The boys sitting across from him looked like they hadn't slept for a week. Mr. Big stood up and turned to the window behind his desk. He took in the breathtaking vista of Highway 101 and said, "Get me more zombies, guys, and you've got yourself a deal. Now, what platform are you going to develop on?" The boys, convinced that they were in a bad dream, suddenly stiffened at the mention of

STATE of the DELIVERY PLATFORM

"what" and "platform." For a moment they didn't know which was worse: the realization that this was no nightmare or the fact that they had to make a decision that would haunt them for the next 18 months and beyond. Suddenly, as if driven by a hidden force, they both chimed, "Crossplatform. Definitely crossplatform."

The VP turned around slowly. The interns seemed to shrink in place. Luckily, the VP recognized the technical term they had just thrown at him. "Crossplatform. Good, good. That's what we like to see at Really Big Games. Yup, lots of platforms. Well, I have another meeting to go to. Nice doing business with you guys. Just give me those zombies and throw in a naked chick."

With a hearty laugh, he led the boys out of the building, patting them on the back all the way.

As they looked back on the monolith that Really Big Games called home, the boys pondered how they would ever manage to work zombies, lots of zombies, into their dream project. All their lives they had dreamt of creating a feast for the senses, but it had never involved crossplatform zombies.

They decided to look in the yellow pages.

The Yellow Pages of Platforms

Merle, the older of the interns, found Zombies in the Pacific Bell Smart Yellow Pages. How right the adverts were. There really was nothing you couldn't find in this canary tome. Richie brought in the coffee and a stack of steno pads.

"Richie, we've got no choice but to let our fingers do the walking. Under Zombie I have found the names of people who may be able to help us choose the platform for our design. They are all zombie experts in their hardware domains."

"I'm delighted!" whooped Richie. "I shall take copious notes. We shall treat this as an adventure. Who do we call first?"

"Apple Annie," Merle answered. "She is the Mistress of the Mac."

The phone rang only once before an excited, but slightly ethereal, voice answered. Apple Annie listened to the boys' questions sympathetically. She hesitated for a moment before beginning her reply.

"The Mac isn't a really great place for zombies to dwell. Although many of our faithful followers are developers of the interactive discipline, bless them all, the market for entertainment software is relatively small. However, it is most loyal. Of course, now we have the Power Mac, and it has the power to handle many of today's entertainment software needs. There's also plenty of system memory, and the Apple is a graphical machine.

"In fact, at this year's pilgrimage to the holy shrine of Macworld there was an endless array of flight simulators on the Moscone Center floor. Many of the problems that the heathen entertainment software developers associate with the Mac are related to the best features of the Mac operating system. The hardware and software are so tightly coupled that it's very difficult to get into the innards the system."

Richie interjected politely, "Why would anyone want to do that anyhow, Apple Annie?"

"Entertainment software is about performance. If anything, we are finding that interactive multimedia in general is being defined in terms of frame rate when it comes to performance. A frame is the time it takes to complete one cycle of operation in entertainment software. So, the basic programming tasks, graphics, audio, and potentially video elements all have to resolve themselves within a specific time slot. The more of these time slots you can fit into one second, the greater the frame rate. Good is 30 frames per second, but in some cases you may be looking at up to 60 frames per second.

"If you have the elements of the program, as I have outlined for you, and you build in the latency of the operating system, you've got a very tight space to work in. Most developers of entertainment software, being the naughty little gremlins they are, look for ways to squeeze the hardware. If they can't do that, it limits their ability to produce compelling titles."

"Does that mean the Mac is not a suitable games platform?" asked Merle.

"No, my child. Far from it. Our followers are starved for good games. They're sadly overlooked because developers view the market as too small, even though the Power Mac has increased the Macintosh's attraction as a development platform. We also have the wonders of QuickDraw 3D, which we're starting to think about touting among the entertainment software community. You see, there's an opportunity there, but it's still relatively limited compared to consoles or that Intel box thing."

"What about Pippin?" chimed Richie, referring to Apple's settop gaming box, much touted by Apple last year.

"Oh, my dear, you are amusing. Pippin is with some Japanese gentlepersons called Bandai. It's their business. I believe it comes out at the end of March over there. It has changed so much since it was announced over a year ago. It is now said to be an Internet box like those quaint ideas from that Mr. Ellison at Oracle. But, you know, it is a powerful little box for a stripped down version of our glorious operating system. Would you like its specifications?"

Apple Annie faxed over the Pippin specs as she told the boys about the first time she set eyes on the Mac.

Pippin
66MHz PowerPC 603
8kB data and 8kB instruction caches
6MB SRAM and VRAM combined
4MB ROM
IEEE floating point unit (FPU)
4x CD-ROM
16-bit video support
Dual stereo 16-bit sound

"Annie, should we do anything on the Pippin?" said Merle, hoping to stem Annie's reminiscences of all her favorite Macs.

"Only if you can produce Kanji. I must go, dear. We're having an LC Appreciation Tea Dance."

Nearly Nearly Johnson

Richie finished taking notes from their conversation with Apple Annie as Merle dialed the number of Nearly Nearly Johnson at 3DO. It took a while, but eventually Nearly answered the phone. Once more the boys explained their predicament.

Nearly, who appeared slightly distracted, spoke very freely, "You know, 3DO is a cult in Japan. We're getting there in other parts of the world, too. It's a great machine. Do you have the specs?"

Before the boys could say anything, Nearly faxed them the specs of the original 3DO player.

3DO
12.5MHz 32-bit ARM60 RISC processor
2x CD-ROM
32kB SRAM
2MB DRAM
1MB VRAM
16-bit display
16-bit stereo sound

"It was the first 32-bit console. Set the pace, boys. You want to license it?"

"Not exactly," Merle replied.

"Don't go believing what anyone says about it not meeting expectations. There are nearly three-quarters of a million units worldwide. There are over 200 titles for it in circulation. We've got the best engineers, and our development tools are among the best. It'll cost maybe $20,000 to get started with us. Come on, what do you say?"

"That seems steep," Richie said.

"Look at all the great features it provides to developers. It was designed by the guys who did the Amiga — what a machine that was! And it's better than any of the cartridge consoles it superseded. It even has the potential to do MPEG decompression. The price has dropped from $699 to under $300. And look at the great titles: *FIFA International Soccer* and *Madden Football*. Even *The Daedalus Encounter* looks better running on this box than on a PC."

Merle had to interrupt. "Look, we know a little bit about 3DO. The company has failed to live up to expectations because it promises more

than it can deliver. It has a credibility problem. No one doubts the technology, but if 3DO doesn't deliver what they say they're going to, around when they say they will, it's difficult to keep the faith.

"Developers need a solid user base, and the original 3DO player seems to be taking a back seat to your new M2 technology. After all, the only companies who really developed software aggressively for 3DO were Studio 3DO, Electronic Arts, and Crystal Dynamics. The first two are strongly linked to 3DO, and the latter has moved on to other platforms."

"I'm glad you mentioned M2. Let me fax that spec through. You should have said something in the first place. Now we're talking," Nearly Nearly burbled.

M2
66MHz custom 64-bit PowerPC 602
32kB cache
6MB SDRAM and ROM combined
24-bit display in 320x200 resolution
16-bit display in 640x480 resolution
MPEG-1 support
32 channels of audio

"Boys, this thing has 64-bit data paths between all internal memories. We're talking about 528MB per second bus bandwidth and 133MFLOPs under the hood. This time we're also doing a lot of software ourselves in Studio 3DO to make sure people see the real power of the chip when it comes out.

"This baby does real multimedia with MPEG video, audio, 3D with hardware Z-buffering,

FINDING AN AUDIENCE

by Omid Rahmat & Mark Giambruno

The platform you develop for depends on your intended audience and the platform they're likely to use. And, usually, the nature of a title determines its audience. For example, you're not going to sell many reference titles, no matter how entertaining, on a console. At least not anywhere but in Japan, where we hear there are entire floors of retail outlets devoted to very unlikely console titles. Adult titles on a PlayStation? Apparently so — but only in Japan.

Market Penetration

While keeping a focused eye on your audience, a few statistics may influence your vision. Various studies show that 32% to 39.8% of U.S. households have a PC (including Macs and Intel-based machines). According to Dataquest, some 33% of those are Macintoshes. According to figures supplied by Odyssey, yet another research firm, 13% of U.S. households have a CD-ROM drive, 4% have a CD-ROM-based game machine, and 37% have a cartridge game machine.

If you were to look at the game console market and include the old 16-bit cartridge platforms of Sega and Nintendo, the world would be skewed heavily toward those two giants. However, it's pretty safe to say that the cartridge business is almost dead for everyone except those who started there. Sega and Nintendo will continue to reap big rewards, but the transition to 32-bit and 64-bit machines will be complete with the release of the Ultra64 later this year. Console manufacturers aim to expand their markets beyond Toys R Us. The price of the new consoles is higher than that of the cartridge systems, putting them into a new category of consumer device. The consoles will come down in price, but there are lower limits imposed by the complex technology these boxes incorporate.

As for market penetration, more than 700,000 3DO multiplayers have been distributed worldwide, with 275 titles available for the system. In the United States, Nintendo has 17 million Super Nintendo systems and 720 titles. On the 8-bit NES (which Nintendo no longer manufactures) the count stopped at 40 million units and 629 titles. The Ultra64 is scheduled for 1996 release. The Sony PlayStation, released in September 1995, has a worldwide distribution of 3.4 million units (2 million in Japan, 800,000 in the U.S., and 600,000 in Europe). By the end of 1995, 52 titles were available for the PlayStation, of which total sales have been 4 million. Ten titles sold in excess of 150,000 units each. Of those, three sold more than 250,000 units and three sold more than 300,000 units.

Sales of the Sony PlayStation outstrip its nearest competitor, the Sega Saturn, by at least two to one. That translates into 500,000 to 1,000,000 units (estimates vary) in the United States this year, discounting the effect of the Ultra64 launch. These figures are eclipsed by an estimated 20 million PC households (again, this number depends on who you ask — Intel projects 22 million *Pentiums* sold by the end of this year, though they don't specify household ownership in their stats).

Yet many developers and publishers are committed to consoles because they provide the best platforms for games. It's difficult to get around that fact. Most big publishers have a development hierarchy with the PC at the top followed by the PlayStation, then the Saturn. It's not something an independent development group can emulate easily.

Many publishers sincerely wish the PC was the only platform they developed on, but they're still waiting to see if it becomes a clear leader in entertainment software. If PCs don't develop a strong games identity, the consoles will continue to dominate among their specific audience of teenage boys.

The PC's greatest advantage over the dedicated consoles is that it offers an audience that isn't handicapped by the generation of their hardware. Okay, you're not going to find a lot of joy trying to satisfy the 386 PC owner as well as the Pentium enthusiast (or Mac LC owner versus Power Mac user), but it wasn't until the multimedia revolution began some two years ago that PCs became consumer products. Therefore, your target PC is likely to have a fully specified multimedia system with at least a 486 processor.

A lot of people have written the Mac off as a viable delivery platform, but if you're into the educational market (and our own figures show that the majority of *InterActivity* readers are), here's a vital statistic: According to a QED study, Apple owns 63% of the K-12 market (that's kindergarten to high school in the U.S.), and 58% of all K-12 computer purchases in the '95-'96 school year will be Macintoshes. Apple's penetration into the Canadian educational market was 32.5% as of the first half of '95.

And don't underestimate doorstops from the '80s. We've heard tales of titles written for the Apple IIe still selling today because of that platform's popularity in schools.

MPEG

Technological elements such as digital video and 3D effects will also influence your choice of delivery platform. Interactive games that rely heavily on video

FINDING AN AUDIENCE

have never been as popular as their sprite animated cousins. With estimated average sales of some 40,000 units, a video-heavy title that sells 40,000 units could be considered a failure in the games business, where the average sprite-based console game sells as many as 150,000 to 250,000. Interactive dramas such as *Phantasmagoria*, *11th Hour*, and *The 7th Guest* (the latter of which sold of over a million and a half copies) prove it's possible to ring up mega unit sales, but those titles are the exception, not the rule. Unfortunately, some of the technologies remain proprietary and debates rage about standards in digital video.

What about MPEG and its role in interactive design? A couple of facts may help you make up your mind:

- An MPEG codec is available with consumer PC systems from all the top manufacturers, except Apple. This codec may be in hardware or it may be software only.

- S3, a leading supplier of graphics chips for the PC, shipped 500,000 MPEG chips in 1995.

- MPEG hardware support is possible as an add-on with a number of the new consoles, although no products are available as of yet. It's already part of CD-i.

- Many PC manufacturers are looking for suitable MPEG titles to bundle with their systems, and there's a recognized shortage of such titles in the marketplace.

Things have never been rosier for MPEG, but it's been a long time coming. Interactive television and broadcast use of MPEG-2 are securing a place for this open standard. On the other hand, some multimedia developers go to great lengths to develop their own video codec technology with little in the way of recognizable commercial gain. It's your call. The fact is that in 1996 and beyond, MPEG is a likely feature of PCs. It's already part of CD-i. It's also going to be available on game consoles in the next 24 months.

The Windows accelerator, or accelerated VGA, chip manufacturers are providing predominantly hardware support for digital video in their products. VGA products commonly provide the following functions in hardware:

- Scaling and interpolation.
- Color space conversion.
- Video overlay over graphics.
- Hardware decompression of MPEG.

To emphasize the integration of more functions in VGA, Jon Peddie, a leading analyst of the PC graphics market, categorizes PC graphics this way:

- Super VGA (SVGA): High-resolution VGA typically at 1024x768 resolution range.

- Accelerated VGA (AVGA): VGA with 2D acceleration predominantly used in Windows accelerators.

- Video Graphics Controller (VGC): AVGA with integrated digital video functionality.

Peddie says, "We can see how MPEG functionality, and now 3D functionality, are becoming part of the baseline functions of the graphics subsystem in PCs. In 1996 the average consumer PC may be a 133MHz or even 166MHz Pentium. That's a of lot of power, and a lot of companies are committed to developing for Windows 95."

Another factor that may shift the balance of entertainment power toward the PC is 3D. Microsoft will release their 3D API, Direct3D, in the middle of '96. More than 30 manufacturers have, or will have, 3D accelerator chips that support Direct3D. The emergence of 3D is making PC graphics more multimedia capable with each new generation of VGA chipsets.

3D

Consumers are faced with an ever greater array of options on which to spend their entertainment dollars. Faced with competition from consoles, online services, video, television, and the upcoming Network Computers (NCs) of companies such as Oracle, the multimedia experience must amaze and excite the user. To a majority of consumers, the PC is an investment in electronic entertainment, and 3D is perhaps the next investment PC users will make.

It's tempting to say that games have limited appeal. (If you doubt that, do a random survey of the adults you know, men and women, asking how they perceive computer games.) However, multimedia 3D offers a rejuvenating shot in the arm to an industry that has been a victim of its own hype. 3D goes beyond games — check out the upcoming *Nature* CD-ROM from WNET, which uses incredible QuickTime VR panoramas of the some of the most beautiful places in the world (browse over to http://qtvr.quicktime.apple.com/ for a preview).

With the recent financial results of companies such as SoftKey, Brøderbund, and Sanctuary Woods pointing to a slowdown in the market, developers have to look at new means of getting their messages across. The high level of interactivity that comes with realtime 3D is going to drive consumer demand for 3D products. Research among the top entertainment publishers suggests that sales of hardware accelerated titles will double in the next three years. Meanwhile, software-only 3D is expected to decline. Direct3D allows a program to poll the hardware and use any 3D acceleration features available — the developer doesn't need to worry whether they're there or not.

The first products to take advantage of 3D PC hardware have been native-only titles running on graphics boards such as Creative Labs 3DBlaster or Diamond Multimedia's Edge3D. Sega has ported their Saturn favorites to take advantage of Edge 3D's concurrent multimedia processing chip from Nvidia. The 3D market is in its infancy and native titles will retain a small niche in the market, but over the next few years, 3D multimedia is going to dominate the bestseller charts for entertainment software. Given 3D's insatiable thirst for processing power and memory, many of these titles will be built for the PC.

It's difficult not to endorse the PC as the main platform for interactive multimedia whether it be entertainment software or not. There's just too big an installed base, too many technological possibilities for leading edge developers, and too many hardware features for multimedia elements such as 2D and 3D graphics, digital audio and video, and eventually communications.

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and MIP mapping. M2 is slated to outperform every one of its rivals."

Richie, slightly confused, had to ask, "What about all that memory? It's going to cost a lot of money. Maybe that's okay in a personal computer or something like the Pippin, but in a game console?"

"You want performance, you can't afford to skimp on memory, kid. We've got a big strategy behind this. It goes into the arcade, into M2 players, and into the PC. We've managed to get those Matsushita guys to pony up some $100 million and they're bigger than any of our competitors. They're going to handle all the developers."

"Matsushita doesn't have any experience doing that. They may have money, but are they going to make the commitment that Sony made?" Merle wondered.

"Hey, it's early in the game, Merle, my boy. You've got to give it a chance. The first development tools are starting to become available. The M2 kit works on a Mac and costs around $40,000. Try it out for yourselves."

Richie answered, "Thank you for your help Nearly. We have to think about this. You're the first console guy we've talked to, and frankly, $40,000 scares us. There doesn't seem to be much room for the little guy, and the startup costs seem pretty high. You guys are supposed to be easier to deal with than some of the others, but that scares us too. Also, the technology sounds great, but it seems to rely on Matsushita, and too many players may be coming into the market in the coming year. They have to prove themselves, no matter how big they are.

"By the way," Richie asked, "why do they call you Nearly Nearly Johnson?"

Johnson smiled. "We've nearly made it, kid. Nearly. Now get lost. I've got some licenses to sell."

The Concealed Console

Merle and Richie took a break and ran through what little information they had managed to gather so far. It seemed that neither Apple nor 3DO offered them a clear path. They reasoned that technology could only take them so far — without an audience, no title would ever make it. It didn't seem like either company was likely to deliver that audience. By shunning direct involvement in Pippin, Apple had relegated it to a mere fringe player, and the Mac, with its 10% penetration into the consumer market, was still a minority personal computer. 3DO, on the other hand, just didn't seem to be able to make up its mind. They screwed up on their original player. The boys didn't want to be impolite about that, but M2 could turn out to be another hype fest. The real entertainment boxes lay in the hands of Sega, Sony, and Nintendo.

Merle found the contact for the three big console players. It was one guy called the Shadowmeister. When they rang his number, they got an answering machine. Merle left a message and waited to hear back from the Shadowmeister, which he did after about 10 minutes.

"Dude, you serious about the console business?" rasped the voice on the other end of the line.

"More like desperate. We just need to know what it takes to develop on the console platforms and if it makes sense," replied Merle.

"Can you give me a hundred bucks?" said the Shadowmeister.

"No."

"Okay, grab a bag of tortilla chips. I like the black kind. And a jar of salsa. Meet me behind the old chemical plant in half an hour."

"But —" Before Merle could finish, the Shadowmeister had hung up.

The boys arrived at the meeting place promptly, but no one was in sight. Suddenly, from behind a giant drum of waste non-fat chocolate, the Shadowmeister revealed himself. He was dressed in the traditional garb of the Ninja assassin and held a baseball bat in his right hand.

"You boys have the chips?" he rasped. They both nodded. "Okay, let's chow and I'll tell you everything you need to know."

Merle and Richie didn't know what all the mystery was for.

"Always the same," the Ninja explained. "You kids come along with your big dreams and bigger ideas, and you think the console business is yours for the taking. I've been in this business

SYSTEM	PLAYSTATION	SATURN	ULTRA64
	33MHz 32-bit R3000A 2MB DRAM 1MB VRAM 512kB ROM	2 x 28MHz Hitachi SH2 1MB VRAM 2MB DRAM 32kB SRAM 512kB ROM	100MHz 64-bit R4200 3MB DRAM
Graphics	24-bit color 256x224 resolution 640x480 resolution	VDP1 processor 32,000 colors 352x224 resolution 640x224 resolution	64-bit custom DSP 16-, 24-, and 32-bit color 320x224 resolution 512x448 resolution 640x480 resolution 1024x768 and 1280x1024 HDTV modes
Sound	16-bit sound 512kB sound ROM 24 channels	16-bit sound 32-voice FM synthesis 16 channels	64-bit sound engine 64+ channels Unlimited voices per channel
Features	4x CD-ROM with 256kB buffer	4x CD-ROM	Cartridge drive

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for nearly five years and this is what I've been reduced to. All because of lousy NDAs.

"You can't mess with these guys if you're a developer. You stick to their game plan and hope you can ride on the back of their success. If you're lucky or you make them money, you get to be a Made Guy. They even let you in on their future plans. But you can never criticize their technology. No, that's an infamy."

"Why do it then?" asked Richie between chews.

"Consoles are the entertainment center in this business. Until recently, the console games business was a $5 billion industry — 20 times bigger than PCs. Can you imagine? There are guys out there — barely out of their twenties — who cut their teeth in this business and made a fortune. Even after the hefty license fees and the exorbitant costs of the cartridges, you still ended up with a big chunk of change.

"But you've got to know your place if you're a developer in the console business. You're right at the bottom of the food chains unless you're

THE ONLINE PLATFORM

by Omid Rahmat & Mark Giambruno

The hottest topic in computer gaming has to be anything with the word online in it, or multiplayer for that matter. If you're going to play games, it's better to play against other humans than against the computer. The best way to do that is either through an online service, modem-to-modem connection, or on the Internet. It just doesn't seem feasible to invite a bunch of people to crowd around your computer screen.

Indeed, the Internet may be the delivery platform of the future. According to Paul Neurath of Looking Glass Technologies, porting retail products is cheaper than doing Internet-specific development. He foresees most online game development coming in the form of network capabilities built into retail software. Current trends suggest that publishers and developers will be providing connectivity as a standard feature.

Console manufacturers are trying to get connected through cable, the Internet, and anything else that will get them wired. Multiplayer gaming on PCs has been a success story due to the proliferation of online services such as AOL and CompuServe. Add the rampant fever for anything Internet related and you have one good reason why the modem business rose by 82% in 1995 and is likely to grow by the same amount again in 1996.

Looking at the numbers from another perspective, a study by Telecommunications Research Inc. shows that 39.8% of U.S. homes have a PC, 24.3% have a modem, 7.8% have an online connection, and 8.1% have an Internet connection. At a recent online gaming conference, Nick Donatiello of Odyssey, a market research firm, offered strikingly similar numbers: 32% of all households have a PC, 18% have a modem, 13% own a CD-ROM drive, and 9% use online services (up from 6% last year).

Oddly, Donatiello notes, while the percentage of homes equipped with modems is growing, the percentage of people using them is down. He attributes this to new computer owners getting modems as part of the system but either not understanding or not wanting what the online services offer.

This may seem surprising to those of us who rely heavily on the Internet and online services to conduct business (and for entertainment), but figures support his contention:

- 30% of those surveyed can't name a single online service, including the Internet.
- 51% of households with PCs don't use their modems.
- 87% of households with PCs don't use the Internet.
- 90% of households with PCs don't use the World Wide Web.

Lest this sound like an overly negative appraisal of the online market, Donatiello points out the potential for market growth is immense, especially when the right content comes along. And the right content can be summed up in a single word. Entertainment, the "6,000-pound gorilla in America's living room."

"If you believe the Web has a future," Donatiello explains, "you have to believe that it's an entertainment future. Entertainment is not typing messages to people or staring at messages like *please wait while artwork is downloaded.* Entertainment is pictures that move." For online gaming, that means animation, and lots of it.

Donatiello also emphasizes that online activity has to get a lot easier if it's to attract the population at large. He tells us 13% of online users play games, but the current state of computing and online access is far too confusing for the average consumer.

"Imagine how popular television would be if you went to watch *Jeopardy* and got a *server reports file not found* error on your screen," he says.

Game machines are an example of simplicity and reliability — 37% of households have cartridge game machines, but only 4% have CD-ROM-based game machines. According to Donatiello, consumers report that the cartridge systems always work while the CD-ROMs are not as reliable. Although 35% to 40% of PC owners say they use their PCs for games, many are frustrated by the technical difficulties they experience trying to install them.

Imagine what it must be like for a consumer to figure out the system requirements printed on a software package given that:

- 44% of PC owners don't know the size of their hard drives.
- 36% of PC owners don't know the speed of their CD-ROM drives.
- 25% of PC owners don't know what processor they have.

"The next 10% of online users is not going to be like the first 10%," Donatiello cautions. "In fact, there are very few people in the world like us technically minded, somewhat forgiving early adopters. Remember this when designing your products and services for the broader market: It had better work."

The Issues

The Telecommunications Bill, for all the controversy over its censorship provisions, represents opportunity for online developers. In the short term, nothing much is going to change the direction of online gaming, but let's assume that increased competition among service providers results in greater bandwidth into the home. That's the key issue for online content developers. It really doesn't matter who builds and maintains the highway — you're going to have to pay someone anyhow. What matters is how much interactive data you can get into the home.

Marty Schoffstall of PSINet believes that due to too many different standards and systems, cable modems are unlikely to catch on for the rest of the decade. He predicts that 28.8kbps modems will remain the standard for the next two years, and he recommends 128k ISDN for best access.

In the meantime, developers can handle online gaming a couple ways. First,

one of the big boys.

"Look at the costs. You pay for everything you get from these guys, including the development kit. Forget the platform issues. It's all about big business. You can't be just anybody and make a PlayStation game. It's controlled like the movie business.

"I'm saying too much. You never know who's listening. Let me tell you what the specs are for the Sony PlayStation, Sega Saturn, and Nintendo Ultra64 before we go any further. These are the primo boxes, and you can either go with all three or choose one. If you give any of them an exclusive with a hot title and promise that it won't appear on any other competing platform for a certain period of time, they'll try to befriend you. We're sitting in the middle of some Japanese corporate war here, but no one is willing to rock the boat because the stakes are so high."

The Shadowmeister rolled out a frayed piece of yellow paper.

Merle and Richie could hardy contain their awe over the specifications of the big three as Shadowmeister continued, "The PlayStation has a fully integrated VLSI chip with a geometry transform engine to back up the CPU. It makes the PlayStation a more rounded 3D machine than the Saturn. The Saturn's two SH2 processors handle the geometry and game logic, the VDP1 processor controls sprites, and the VDP2 display processor lets you generate five back-

determine your audience's minimum configuration. With console systems, it's relatively simple because all your users have exactly the same box. The limitation is that you'll probably only be able to get two console users to dial each other up and play one-on-one.

With the PC, the issue is more complex because each user's system, and hence each node, represents a different set of system parameters. To overcome this obstacle, game designers are producing engines that handle network protocols for games. One is the Game Connection Protocol (GCP) from Sirius Software, an add-on module for MajorBBS that allows users to enter a game channel and play modem-to-modem games interactively. The documentation for this protocol explains several issues involved in programming online games. With GCP, you can develop games that work through MajorBBS, and most important, they can be written to play solo, modem-to-modem direct connect, or via Game Connection.

The Game Connection model of using a controlled subscription BBS for online game connection is one that will dominate the online games market in years to come. The idea of a central service point for a game network holds many advantages, including a captive audience. It also makes marketing your titles easier, because you can afford to give away solo versions of your products and register paying users for multiplayer versions.

But Can You Make Money Online?

Looking for venture capital for your title? Don't count on it. According to Jonathan Feiber of Mohr and Davidow Ventures, venture capitalists are investing in businesses, not titles, and are likely to operate that way for some time. Ruthann Quindlen of Institutional Venture Partners points out that most game companies didn't start out with venture capital and neither will the online title companies.

When it comes to making money with games, the jury is still out but online may be the way to go. Quindlen notes that Viacom New Media's president has said it's very difficult to make a profit in game software, since development expenses outstrip recoupment. They expect online to change that through a subscription/installment model.

Jeff Braun of Maxis agrees that the pay-per-use model is compelling for companies and investors, and he sees profits arising from millions of "nano transactions," small amounts of money coming from vast numbers of people.

Sega's trials with the Sega Channel are a harbinger of other possibilities in online gaming. Sega hopes they can have two-way communications between cable subscribers in the near future, allowing them to extend the Sega Channel concept to incorporate multiplayer gaming.

With the passage of the Telecommunications Bill, cable providers are free to act. The lack of interactivity across cable and the limitations on cable bandwidth are the only barriers to market acceptance. Still, the Sega Channel is a nice way of selling old 16-bit consoles.

However, another pioneer of online gaming, Catapult Entertainment, has found that the decline of 16-bit consoles has reduced the audience for their XBand modem. XBand was the choice of direct-dial, one-on-one console players, and rumor has it that Catapult will provide technology to Sega for their Saturn Internet connection, scheduled for release sometime in the first half of this year. Nintendo and Sony also are expected to have Internet connectivity by the end of '96.

Online services such as CompuServe and AOL already have established multiplayer game forums. In fact, these are among the most popular areas of their services. The limitation of online services is that during peak usage times, performance degradation is unacceptable. They do, however, provide a comprehensive model for making money out of online gaming. As soon as a user is connected, the meter starts running.

But will these services be able to provide guaranteed performance? Will they offer the best royalty deal for developers? It remains to be seen how these services position themselves as the Internet firmament becomes increasingly competitive.

Services like CompuServe make it very easy to download shareware and game demos — an excellent marketing source. Online services reach all age groups and both sexes. Their potential may even provide relief from the shoot 'em up mentality of many games. Since the success of games depends very much on word of mouth, demos can help by providing players with free play time with your products. Uploading your demos is free and easy in CompuServe's forums. Visit the Games Developer's Forum to make some developer connections, too.

Games are inherently social. You're unlikely to attract much attention if you can't at least show some element of connectivity in your titles. That's the reality of today's market. There's no certainty that online gaming is a great business opportunity. It all boils down to game play — not technology. Make compromises in any other area of your title, but never sacrifice the experience of game play.

CONFERENCES

A few dates for your calender. The Computer Game Developers Conference is a must for any developer in this business (March 30-April 2, Santa Clara, California). E3 is where you go to make deals, but if you ignore the BS you'll get a feel for what's happening in the marketplace (May 16-18, Los Angeles, California). WinHEC is the Microsoft hardware developers conference and is a good opportunity to befriend the 3D chip developers (April 1-2, San Jose, California). Siggraph is a taste of things to come (Aug. 4-8, New Orleans, Louisiana).

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grounds and rotate two. In all, the Saturn has five processors with an impressive sound system based on the Yamaha 68EC000 processor. There's a lot of DSP magic under the bonnet, so if you like to get into a system at the lowest level, you can do the math in a lot of ways.

"The PlayStation is cleaner. It's got good compilers and Sony's pretty touchy about their development libraries. As developers learn more about the way Saturn works, they can create better games, but PlayStation is moving a lot better in terms of sales. They got the first bite of the cherry."

"Okay," Merle broke in, "but you mentioned the Ultra64, and that isn't really out yet. I mean, we know a little about the M2. It's supposed to be superior." Merle hadn't been a believer in consoles up to this point, but he could see the challenge in developing for one. And the market was looking well defined.

"Nintendo and Sony originally were supposed to be partners, but it seems the Big N has a mind of its own. The split humiliated Sony and they ramped up their development of the PlayStation. Nintendo's still king in Japan. They're not that far behind Sega in North America. No one dares

MPATH'S BRIAN APGAR ON THE FUTURE OF ONLINE GAMING

by Mark Giambruno

Mpath has developed the Mplayer GameWay service, which overcomes the key technical blocks to fast-action multiplayer gaming on the Internet: speed and latency (lag time).

By combining its proprietary software with PSINet's fast nationwide network, Mpath plans to support online twitch games with simultaneous two-way voice communications as well as chat areas and other opportunities for social interaction. Many industry insiders believe voice communication is one of the features needed to appeal to the mass market.

Mpath is currently working with several leading game developers to port their products to this new service as well as develop new games. They offer technical support and tools, and will provide revenue to developers through game usage royalties. The system is expected to go online in spring '96.

We spoke with Brian Apgar, Mpath's executive vice president of development, a few days after the Mpath Internet Game Developer Conference.

How will the recent passage of the Telecommunications Bill affect your plans?

No real effect in the near term. I see it mostly as a good thing. It promises free and unfettered competition. However, it may not turn out to be such a great boon to competition and lower prices in the long run because people will tend to use the big brand names or settle on one provider for all their telecom needs.

Do you or your developers have much concern about the bill's effect on online games? For example, is id software concerned that *Doom* might violate a community standard somewhere?

No. We won't offer anything that could even remotely be considered indecent. As to the whole decency issue in the Telecommunications Bill, I see it as a political issue — it's this year's rap music. Eventually it will settle down. The Internet is like any big city — there are places in it that you wouldn't want your kids to wander around in. I think the market can take care of the problem. We don't need Washington to get involved. For example, there are products out there that protect kids, and they will only get better. As for us, we plan to offer extensive parental controls for our system, allowing them to limit the times of day the system can be used, for how long, maximum fees for a given period, and so on.

What are your thoughts on using the Internet as a marketing medium?

We think the Net is a great marketing medium, allowing the customer to get information fast and make acquisitions easier. Advertisers seem to recognize that, and some of the Web sites out there are well financed by advertising. In fact, the nature of our system, which will require an account relationship, will give advertisers lots of good demographic information about our subscribers. In return, the advertisers will pay more because they know their product is being seen by just the kind of people they're targeting.

Many games, like *Doom*, offer direct modem connections for two players. What advantages does your system offer over making a direct connection?

Using *Doom* as an example, we can have up to eight players competing simultaneously. We place a lot of emphasis on larger multiplayer games, those involving four, eight, or even 32 players. These games can take the form of individual or team competition. We also see a great deal of value in our matchmaking abilities, ensuring that you find players of your own skill level to compete with, and allowing you to choose the game options you like. We'll also track scores for the purpose of creating game ladders for tournaments and competitions. Of course, one of our biggest advantages is that we offer speech communication without any special hardware, so you can talk to each other while you play.

How will people access your service? Is it only available through PSINet?

Let me clarify, since some people have gotten the impression that you have to use PSINet to access GameWay. We guarantee that gameplay will be best through a PSINet point of presence (POP), but it will be acceptable through most Internet providers. In fact, when you connect, we'll do a dynamic test for the speed and latency of that connection. At that point, we'll alert you if the connection won't support certain high-speed games. We plan to offer a wide range of games with different latency requirements so people will be able to play at least some games through just about any connection.

What makes PSINet's connections superior for GameWay users?

We will be placing game servers throughout PSINet's system, interconnected with high-speed pathways. PSINet has designed the connections to guarantee that packets are delivered and that GameWay traffic has first priority. From a technical standpoint, many providers have connections that go through multiple routers, any one of which could be bogged down at a given moment, slowing your packet. PSINet uses an ATM frame relay network with routers at the periphery only. Internally, they use switching technology that doesn't suffer from the same congestion problems. Between our proprietary software technology and PSINet's speed and reliability, we'll be able to give the subscriber a gaming experience that's unavailable elsewhere on the Net.

to count them out. Who cares that they're sticking with cartridges while everyone else has moved to CD? The CD drive added too much extra cost for their liking, and they can put memory in the cartridges that they may have had to put in their console otherwise. Expensive? Yeah, but again, who's arguing?

"Each system has its merits and drawbacks, but they're not glaring enough to make one jump out at you as a development platform. It depends on the money and which guy decides to go with you. You guys can't be that big, right?"

"Well," Merle thought about the team they usually employed, "we can't get by without at least two to five graphic designers, the two of us do programming, and maybe two other guys. That's as lean as it gets right now, and our biggest cost is wages. Equipment is pretty much leased as we need it. I don't think we can afford to pay the cost of the development kits that the console guys want up front. Yet, there doesn't seem to be any way around it."

The Shadowmeister pondered the boys' predicament. "Yup, you're pretty lean. It's not like the old days. Now you've got to have the best graphics and they eat up budgets big time. As for the console makers, with no track record you need a very compelling reason for them to treat you special. It's like pitching any publisher on a project, except that you tend to bear most of the costs — but that seems to be the way these days. Too much supply for demand.

"I'm also seeing a lot of these console hombres take work in-house more often than not. They think they can control costs and get a jump on their competition with better quality control. Sony learned this the hard way when the PlayStation first came out. Now they're putting a lot of effort into their own stuff and working with just a few select groups, which usually are really strong teams."

"So what do we do?" Richie asked.

"Don't get into the entertainment software business for money. You may not make that much. It's a hit driven business. If you want to get into the console business, a track record helps like nowhere else. But you don't necessarily need to have any previous console work in your portfolio. It's not that different from developing on any other platform. C compilers are pretty good and you can tweak things in assembly language if need be. You have memory limitations with consoles, but there are lots of little nooks to put things in. That's where the hacking comes in."

The Shadowmeister ate the last tortilla chip slowly, carefully listening for the initial crunch. He smiled for the first time. "Boys, I can't tell you much more. You get too much information and the console guys will get scared of you. Paranoia is not a pretty sight in this business. You want to find out what the real technical issues are, get hooked up with other developers. It's a great community. It's not technology that drives these guys, but game play. Technology just helps to get it up on screen. Stick with the right crowd and you'll get all the information you need."

"What are you going to do, Mr. Shadowmeister?" Richie felt admiration for this grassroots hero.

"I don't know. Wherever there's an NDA, you'll find me. Wherever there's a big corporate games box, you'll find me. Wherever there's a game developer in despair, you'll find me. Ciao amigos."

With that he stepped back into the dark and disappeared.

The Ashram of Eternal Openness

Merle and Richie were exhausted when they arrived home. However, Merle decided to make their final call to the PC Poobah. He got through, but the Poobah suggested that they meet at his prebreakfast meditation. They'd talk afterwards.

At first light, the boys made their way to the Ashram of Eternal Openness. They arrived at one of the better neighborhoods, Stepford, just as the masses were entering the doors.

When the Poobah came to the head of the gathered throng, there was an almost immediate silence. He surveyed the crowd, smiling at some and admonishing others with his eyes. He paused for what seemed an eternity, but no one seemed to mind. Then he began.

"There is a great device. One that is not tainted by the sin of closed systems. One that does not require the heavy payment of licensing fees. One that is pure and widely available. It is the PC and it flows with the karma of Windows."

The crowd screamed in delight. Suddenly, the boys noticed a bright light at the back of the Ashram, and a pure white cloud revealed itself with these words shining through:

Holy PC
133MHz Pentium processor
256kB cache
1GB hard disk drive
Accelerated VGA with 1MB of display memory
16-bit sound

Once more the Poobah spoke. "Millions have come to the PC love-in. Millions more follow as we speak. How can some be blind to the installed base? How can some be blind to the multitudes of system memory? How can some deny that today it is 133MHz, but by the end of 1996 it will be 166MHz of pure Pentium power? Who does not feel the cosmic energy of the power under the hood?"

"Ohm!" the assembled faithful intoned.

"Even the Sega, the 3DO, and the Atari now embrace the PC of love. They have found peace in Windows 95, where they have more processing power and a games API called DirectX. They will have Direct3D — a 3D API — that will level the playing field of 3D multimedia for some and create greater achievement for others. There is no barrier to market entry. It is only a matter of personal belief.

"I have seen many manifestations of the grand vision. Billboards that once proclaimed only the console now hail the PC foremost in their marketing. Crossplatform development? It is all with the PC today."

A wild frenzy of spiritual fervor took over the crowd. The Poobah raised his palms a number of times before the crowd became quiet again. A small, unshaven man dressed in Armani stood up slowly

"He Who Walks on Flowers, you wish to speak?"

He spoke in a voice almost inaudible. "I made a fortune selling cartridge games, but now I see that the PC is really a worthwhile platform for entertainment software. I feel liberated. I don't have to worry about the high costs of manufacturing according to the demands of some console company. I don't have to pay anyone a hefty licensing fee. I've got more talented people to hire. It's hard to find good console guys, but not so hard in the PC market because more people are trained on a PC. I'm hoping that eventually I get to support only the PC and maybe one other platform."

"Friend, are there any barriers to entry?"

"No, Master Poobah, sir, there are not. Anyone can get going. We're seeing a lot of first-time developers come on board. I mean, competition can only be good for business because it raises the overall quality of what's being made.

"It's difficult unless you have the resources to plan for multi-platform development. Big publishers have catalogs of titles so they can afford to be wrong here and there. Otherwise, you end up killing your business. For us, the PC is a great starting point.

"Don't forget that it's also a great communications box. I don't mean just for multiplayer games across the Internet. Online marketing is really cost effective. You can put up demo copies of your titles for downloading all over the Net, spread the word, and do all kinds of things that would require a huge marketing budget by any other means. You also know you're reaching your target audience. With so many titles out there, you need those kinds of control over how your message gets out. You just can't do that in the console business. I guess in the console days I was a Royalist, and now I'm becoming a populist."

"The PC is king now," laughed the Poobah. "We hear your words, but now we must hear from another and give to him freely of our love."

"I'm over here, Master. My name is Gus, and I just wanted to talk about the cool things happening on the graphics front with the PC. We've got these great VGA cards that move bitBLTs and windows fast enough, and we've got digital video capability across the board. If it ain't there yet, it will be by the end of this year. Now we've also got 3D accelerators coming on board. Everyone is hoping that Direct3D acceleration is going to be the standard in the coming 18 months. You'll be able to do really amazing, interactive 3D multi-

STATE of the DELIVERY PLATFORM

media as a standard feature. Fully rendered, Gouraud shaded, perspective corrected, texture mapped, Z-buffered graphics at your fingertips. The 166MHz Pentium is going to be widely available to consumers by the end of this year. How much power can you get on the desktop?

"I see the day, Master, when everything interactive will be high quality, rendered on the fly, 3D, and not your prerendered animation stuff. The movie that leads into the interactive part should *be* the interactive part."

"Ohm!"

"Friends!" began the Poobah. "There is no console in this world that can do that, but we wish openness and love for all. Let it not be said that we want the end of the console. We will co-exist, but we will supersede, too. For the console will remain a toy, an expensive toy, but a toy nevertheless. It has not the keyboard input, and it is therefore not designed for anything but the twitch factor. The console mongers control too much the output of our glorious developers. This is not a good thing. It is not the job of man to determine the limits of creativity, for no man must be allowed to kill the spark of ingenuity."

The crowd departed in high spirits to the sounds of the Carpenters playing over the PA system. The boys waited until the Poobah had placed a Windows insignia on the forehead of the last of his followers. Then they approached him. Richie enthusiastically clasped his hands.

"That was marvelous Master Poobah. I feel so peaceful. We've been trying to figure out the

CDi: A DEAD HORSE RIDES AGAIN

CD-i? Philips' pet interactive format has long been written off as a viable delivery platform in the United States, where only a few thousand units have been sold. And while Europe has an installed base of some one million CD-i players, we've heard that even publishers of some of the best-selling CD-i titles are focusing on the PC as their delivery platform of choice.

But a different story is being played out in the land of point-of-purchase information kiosks and corporate computer-based training — markets for which self-contained CD-i players, with their ability to play MPEG video, are particularly well-suited.

"Everyone thinks they're going to get into the CD-ROM business and get the lion's share of the market," says Mike Alford, Philips' marketing manager for CD-i. "But that business is really competitive. Almost no one is making money in it. The average number of titles released in a year is in the thousands, while the average amount of shelf space holds something like 82 titles. Most of those developers are not going to make a living in that kind of environment.

"CD-i development is a different market. It's for professionals doing computer-based training and point-of-sales kiosks. It's a billion-dollar industry in and of itself. We've already penetrated most of the Fortune 500 companies — Ford, Chevrolet, etc. Many retail chains are using CD-i to train their employees."

According to a study from Venture Capital Specialists, approximately 22% to 23% of the electronic kiosks sold in '94 and the first part of '95 were CD-i players.

Developing graphics for CD-i isn't like developing graphics for PCs. As Alford puts it, "You're not developing for a computer monitor, you're developing for a TV set — something that's going to be watched from three to six feet away instead of 18 inches. We're capitalizing on that because you can buy a 50" wide-screen TV for the cost of a 20" computer monitor. We're looking at CD-i as the machine to replace an MPEG computer in a kiosk box. We can do it for about half or a third of the cost. It just makes economic sense."

JCPenney is one of many companies using a CD-i-based kiosk network. Alford explains, "JCPenney has a big database. Customers can pull their sister-in-law Sally's record from a thousand miles away, figure out what pattern of china she wants, order, and have it shipped to her just by standing there and scanning their credit card at a kiosk. You don't need a salesperson. Once the company puts in the investment, about $13,000, they're in good shape.

"It's an interesting marketplace now, with downsizing across America and major retailers not doing real well. They're all interested in lowering costs. They want to put in kiosks, some sort of bodiless information system. Last year, something like $270 or $280 million dollars worth of electronics went into interactive kiosks. In three years, it's expected to be $2.3 billion. CD-i was predicted to go down in terms of market share. We were going to go down 23%. We went up 18%. Everyone thought CD-i wasn't workable for kiosks because you couldn't network to a database. That's changed."

The Philips CD-i370DV is a self-contained portable presentation tool priced under $2,000. Weighing just under 4 pounds, complete with power supply or battery, it's lighter than most notebook computers. It features a 5.6" screen and connects with any TV or AV monitor. An infrared pointer is included and a mouse and other input devices can also be used. The unit supports CD-i, Enhanced CD, Photo and Video CD formats, and MPEG-1 video.

The Philips CD-i Pro Desktop (CDi615DV), priced at $1,295, features four serial input/output ports and a Centronics parallel port that allow users to operate up to five devices simultaneously, including modems, printers, keyboards, touchscreens, and other pointing devices. The unit supports standard CD-i format, regular and enhanced audio CDs, Photo or Video CD formats, and MPEG-1. Operating the player is a plug-and-play process, followed by point-and-click action.

CASE STUDY: LIFELIKE PRODUCTIONS

Taking Titles to New Platforms

Crossplatform development is a specialist art, and few developers are in a position to do it. The reasons for this can be numerous but commonly include lack of time, focus, and in-house expertise. Often, developers turn to companies who occupy this specialist development niche, companies such as LifeLike Productions.

The company is situated on the top floor of a beautiful Victorian building in Sausalito, California. After you negotiate the narrow steps, you reach a room filled with PCs, Macs, video units, recording systems, televisions, and the wonderful blue developer's version of the Sony PlayStation. The rest of the company winds its way around this main room like a miniature maze. Programmers work in solitude in various rooms. Occasionally, a programmer ventures out to pick up a soda from the fridge, also in the main room. I was struck by the relaxed atmosphere at LifeLike. As I was shown around the offices, I noticed that everyone's space was tidy in a way that belied the archetype of grunge-infested programming dens. These guys were very professional. In their line of work, you have to be.

LifeLike was founded in 1992 by developers from Autodesk who decided to cash in their stock options and head for the more glamorous world of interactive multimedia. Who could blame them? Computer aided design (CAD) is the computer equivalent of Sisyphean labor. The two principals of the company are husband and wife Tim Edwards and Katherine Williams. Edwards worked on cyberspace and multimedia projects at Autodesk, while Williams was involved with Mac programming. They are joined by senior programmer Erik Strickland and sound expert Theodore Apel.

Lifelike Production (Left to Right) Erik, Tim, Katherine, Ted

They began their venture when they went and bought a 3DO development kit, just at the moment 3DO was kicking off. "We talked their salespeople into giving us a job," Williams says. "The job they gave us was for a 3DO kiosk." 3DO kiosks are commonly situated in consumer electronics stores next to the 3DO merchandise, where they run demos of 3DO titles.

Edwards continues the story of their first development system. "We started out with the original Blue Station, which was a flat PC case with no CD-ROM drive; just a board and some RAM. It hooked up to a Quadra 800 Mac. Initially, we could just write code, and nothing went to CD. Later we were upgraded to a Red Station, which had a CD-ROM drive."

The beginnings of LifeLike mirror the experiences of most developers wanting to break into the lucrative console market. They chose 3DO because the company offered them an entry to the market and provided a set of development tools they were comfortable with. LifeLike was among the early adopters, apart from 3DO's main software partners, Electronic Arts and Crystal Dynamics. Today, the cost of entering the same business is higher — M2 development kits cost twice as much as their predecessor. Competition for the small number of spots available to new developers is steep. With budgets for console titles running in the millions of dollars, it's hard for small developers to succeed on their own merits.

LifeLike has maintained a strong business by carving a niche for themselves as a provider of programming services. They plan to develop their own title in the near future.

Their first productions for the 3DO platform were samplers. There was no glamour in this work. However, the company learned how titles and genres work on the console. Edwards likes to think the discipline he acquired at Autodesk is a key skill in developing multiplatform projects.

Managing Assets and Memory

"Developing for consoles means you have to keep programs tight. You can't allow any extra lines of code or get sloppy in software management," says Williams. "If you're used to developing on the consoles, you become focused on memory and timing issues to a degree that makes your overall programming skills better."

Edwards adds, "The 3DO was just like any other 32-bit platform, so it wasn't as different as we thought it was going to be. I worked on the Cyberspace Development Kit, a virtual reality toolkit at Autodesk, and we were experienced working with some pretty esoteric hardware anyway. Also, on the 3DO, the development environment was Macintosh. Katherine knew how to set it all up, so that was easy too."

"It always comes down to memory, speed, and timing issues," Williams echoes. "On the first game I built, that's what I ran into. You have to make an application that will run consistently over a long period of time, that won't crash. Things have to happen in a timely manner, like within less than a second. You have to deal with art issues: How are you going to get it all into memory quick enough? What will fit in memory? Not a lot."

By successfully bridging the knowledge gap between their PC and console expertise, LifeLike has become an established porting house. They've done such diverse projects as porting the 3D flight simulator *Flying Nightmares* and the video-intensive *Daedalus Encounter* to 3DO. *Flying Nightmares* proved a particularly daunting challenge because of the way the program was written. "The issues there were all memory," Edwards says.

"When you're porting a game that takes eight megs of RAM on a PC, you have to cut down on the amounts of art and sound in memory. You also have to cut down on the size of the sources," Williams advises.

LifeLike went through the source code religiously. They pared it down where they had to, and they also ensured that it was robust enough to run continuously. "No memory leaks," as Williams likes to say.

They admit now that the biggest mistakes they made were trying to add extra features that the console's memory constraints could not support. *Flying Nightmares* is a flight simulation, and LifeLike thought that by adding texture mapping they could enhance the realism of the 3DO version beyond that of the Mac and PC versions. However, they found that flight simulations don't really benefit from texture mapping. "You spend most of your time on the flying, and objects are too small and too far off for textures to add much realism," Edwards says.

LifeLike expended the most effort on making sure code was optimized, because the 3DO processor was not as fast as its PC counterparts.

With the *Daedalus Encounter*, LifeLike had to start from scratch. Mechadeus, the original developers, gave LifeLike an engine description, which they used to rebuild the game entirely for 3DO. In some areas, the 3DO version of *Daedalus* looks better than its PC equivalent.

"The biggest issue in converting multimedia for other platforms is that far too often, the art assets aren't kept in a methodical fashion. We've seen cases

LIFELIKE PRODUCTIONS

where the original art is scattered around, not kept in its original form, and not archived well at all," says Williams. "The other issue is the resolution of the art. On the Sony PlayStation and the 3DO, you can use 24-bit video and 16-bit art. A lot of the art on the PC is 8-bit. Our main advice to developers is keep your art at its highest resolution, easily accessible, and archived well. Otherwise, you can kill a porting project."

Speed issues drive PC developers to keep their art in 8-bit formats, but you need 16-bit graphics to make your work look good on a television set. Resolution, on the other hand, tends to be better on the PC. Most consoles display 320x240 and 288x216 resolutions, so often you need to scale down images. If you start with previously squashed images, then subsequent shrinking for different platforms results in unacceptable degradation. The new accent on higher resolution and greater colors on the PC means developers are starting to use 16-bit art more regularly.

Porting Schedules

The time it takes to port titles from the PC to console platforms depends on several variables, says Williams: "How well the assets were archived, how big the game is, and how much paring down we have to do to accommodate memory restrictions."

Both *Flying Nightmares* and *Daedalus Encounter* took nine months of solid work. That's a full production schedule for most developers. For LifeLike, it means sometimes becoming detectives, searching for the right assets.

In the meantime, they see more companies putting more effort into proper care of their assets. The high cost of quality graphics makes them precious. Companies are also realizing that crossplatform development increases the variety of potential revenue streams, adding to the profitability of a title. Spreading a title's exposure across a larger base of users by addressing more platforms should be an essential element in any developer's strategy.

Experience has taught LifeLike the pitfalls of porting. It was not their initial focus, but it has helped them become positioned as crossplatform developers, putting them in an excellent position to realize their own title development ambitions.

"If you plan from the very beginning to support a number of platforms, then it's cost effective to produce a number of versions of your title in parallel. We aim to use our experience to make sure our own titles cover a lot of bases right out of the gate," Edwards says.

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STATE of the DELIVERY PLATFORM

best way forward in our development, and you've really taught us how to zombie. I just hope we're doing the right thing."

Merle went up next. "My friend is right. We are now closer to understanding the path forward. However, I wish to ask a few questions."

"You must be the boys who called earlier. I will surely try to help you as best as I can, my son. Go ahead."

"While I agree that the PC has none of the barriers to entry that the consoles impose, and that it has far surpassed the Mac in terms of popularity, I'm slightly concerned that it's too expensive for an entertainment system."

"Good point, my son, but you've got to remember that studies have shown that 70% of the time, a home PC is used for entertainment purposes. On top of that, you've got the super cool Internet stuff, education, and home office work. I mean, it never stops, so no one sees it as a mere entertainment device. It is truly a beautiful thing."

"Why?"

"Because people expect greater things on the PC. 3D tools are becoming available on Windows NT that previously ran only on Silicon Graphics-type workstations. The tools are migrating to the platform of use, so we're going to see some pretty amazing graphics on the PC. If the expectation for software on the PC is greater than for other platforms — don't forget, a standard system by year end will be a 166MHz Pentium — better software will be developed. Too many companies, above all Microsoft, have a big stake in making this happen for the possibility to exist that it won't. The PC will not kill the console business just as it won't kill the workstation business, but it will change the nature of the console business. We want openness and love. It seems very negative not to focus on the PC at this time.

"There's no memory constraint, really, and the processor is levitating higher in terms of performance. The add-in card business provides a load of new options for developers; they can build extra hooks into their software to take advantage of hardware accelerators and gain a competitive edge. Ultimately, consumers drive the market. They want the special effects in movies. They want *Jurassic Park* on their desktop. It is the way of the righteous.

"My sons, I'd love to talk some more, but I have to anoint some new disciples. Here is my email address. If you need any more help just hum."

The boys watched the Poobah go back into the Ashram. The doors closed gently behind him.

The Walk Home

"Richie, what do you think?" Merle asked.

"Merle, my friend, I think we're going to go down the PC route for now. We'll develop and demo on this platform. I'm not sure we're truly cut out for the job of hardcore games design. I think we can develop simultaneously for the PC and Mac. Somehow, I don't want to abandon the Mac. It doesn't seem right, and if we plan in advance, we can do it with relative ease. We'll see about porting to other platforms if there's a demand."

"I agree with you, but we are going to need to build a lot of zombies, and it may be better to develop on the console. You heard what that Vice President gentleman said."

"Why do you say we have to develop on the console first? Moving C code from PC to console isn't the difficult part."

"I'm thinking more about the memory constraints. If we start to build on a console, we can keep our code optimal and tight. We also have to live with the memory and bandwidth constraints. And there are no compatibility issues with consoles. You build a program to work on a PlayStation or Saturn or Nintendo, and it'll work on all PlayStations and Saturns and Nintendos. That isn't necessarily true on the PC."

"You have a point, Merle, but Microsoft is doing its best to remove the compatibility issue from the equation. I can see how developing on a console first encourages discipline and makes porting to another platform less trying. I suppose it comes down to commerce."

"Yes, Richie, it comes down to your target market. Interactive multimedia or games?"

They took a few paces in silence.

"I can't stop wondering how we're ever going to fit zombies into our project, Merle. That remains our main problem."

"You're right, my friend. When we first thought of doing an interactive multimedia title on the joys of ballooning, we sure never thought it would turn out this way."

"No, we didn't."

ABOUT THE AUTHOR

InterActivity **contributing editor Omid Rahmat is one of the principles at Siren New Media. During his spare time he researches market trends on a mercenary basis.**

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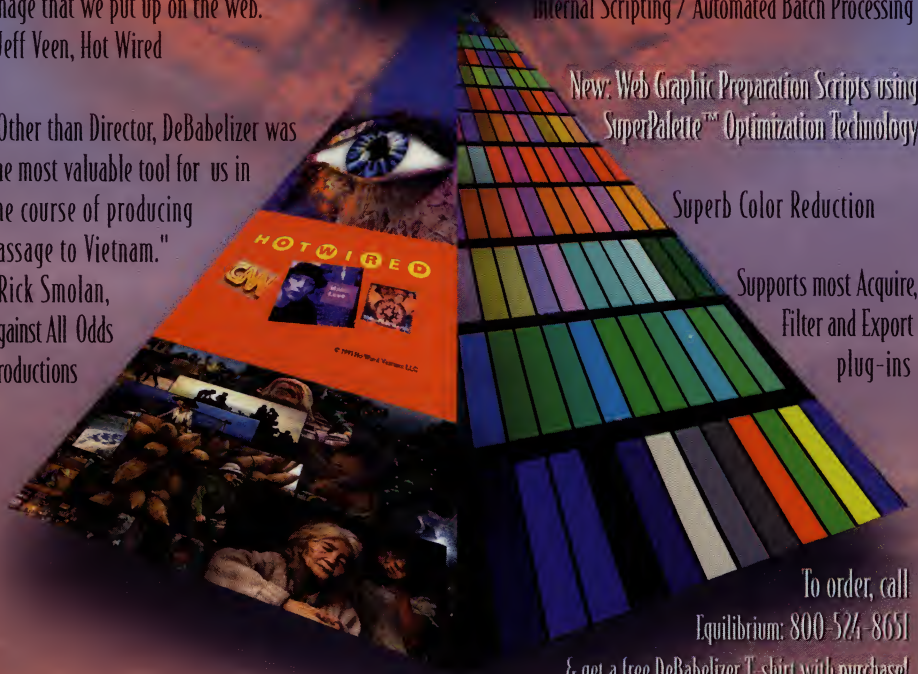

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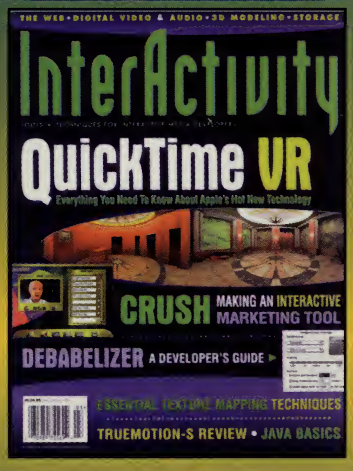

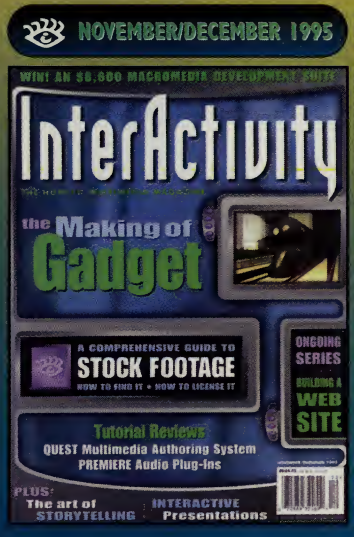

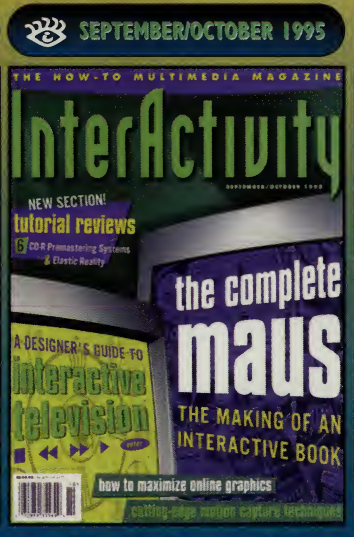

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AN INTERACTIVITY SERIES

how to PUT TOGETHER an INTERNET WEB SITE

PROGRAMMING JAVA APPLICATIONS

For much of this series, I've written about tricks and tips for setting up Web sites that are truly interactive, that do something more than present static information to an unknown reader. Great Web sites are those that react to users, remember their name and preferences, what they've read, what they might be interested in, and their browser's limitations and abilities. ■ But the combination of HTML, CGI, and low-bandwidth modem PPP connections sets limits — relatively low limits — on what can be done. HTML is a wonderfully elegant way to specify text, but it lacks the typographic precision needed to design a distinctive page. CGI is a powerful programming standard, but it's limited to server-side programming. You can get around those limitations by using server-side pushes and graphics files, but a 14.4kbps modem connection just isn't fast enough to keep up with the rapidly advancing state of the art in Web design. ■ Many Web designers like to pretend their target market is accessing the Web using medium- to high-bandwidth (ISDN and better) networks. The truth is that the average access speed to the Web is *decreasing*. As more and more

BY LARRY O'BRIEN

how to PUT TOGETHER an INTERNET WEB SITE

people log in to the Web at home, the number of attached 14.4kbps modems (or worse) is outpacing the growth of higher-bandwidth connections. Sure, the low end will max out fairly soon, but 1996 is still too early to design for 56kbps+ connections. This goes for professional sites as well as amateur — I've been involved in four sites targeted at professionals that were originally approved for high-bandwidth designs, and each of them has done a change-order to lower the bandwidth consumption.

Java provides one of the nicest tools for spicing up a Web page. Let's be absolutely clear on this — you don't need to know anything about programming to spice up your pages with Java applets. You can use that time-honored Web tradition of saving a page you think looks good, cutting out the text, and inserting your own text between their HTML tags (a tradition that can run athwart copyright law if taken to extremes — limit yourself to lifting small sections of HTML that illustrate techniques you haven't yet mastered). When specifying a Java applet, the tag looks something like this:

```
<APPLET CODE=classname HEIGHT=100
WIDTH=100>
<PARAM NAME=variable_name_1 Value=value>
<PARAM NAME=variable_name_2 Value=value>
If you see this text, you don't have a
Java-enabled browser.
</APPLET>
```

The CODE parameter in the APPLET tag specifies a single Java class. This class almost certainly uses other classes, which will also be downloaded if they're not available on the client machine. So if you're using someone else's Java applet, be sure to double check that you've made available to your site not only the applet program, but all its supporting classes. You need to make available only the compiled classes, not the Java source code.

At this early stage in Java's evolution, text effects are likely to be what you're using Java for. Java-enabled browsers are still definitely in the minority, and you should be viewing Java as site spicing, not the main course. Text effect applets such as nervous text (which jiggles about), marquees, and LED-style signs (just like the ones you find in your better pizza restaurants!) are eye-grabbing ways to make your Web site stand out.

Creating Text Effect Applets

What goes into the making of a text effect applet? Well, you need a Java development tool, a working knowledge of the language, and a little patience. The Java language is a project of Sun Microsystems. However, the command-line tools of the Java Development Kit leave much to be desired, at least in comparison to the tools professional software developers are used to. Java is going to be the next big rage in programming, and all the major development tool vendors (and some minor players) are racing to deliver programming tools.

I guess when a product's in beta testing it can't be said to be "out of the gate," but Symantec seems first out of the paddock with its Espresso programming environment for Microsoft Windows, the first widely available integrated development environment for Java. You can get Espresso from http://www.symantec.com and on CompuServe's Symantec Development Forum (GO SYMDEV). Espresso is available as a patch for the Symantec C++ development environment. In other words, to try the Espresso development environment for free, you have to have ponied up the dough for Symantec's C++ development environment.

To save screen space, Espresso lets you lay out windows in five contexts — editing, browsing, debugging, building, and a generic output context. You switch between contexts by using a tabbed notebook control at the top of the screen. In theory it's nice, but in practice it falls a little short since Espresso doesn't yet provide a graphical window for debugging Java applications; you do that inside a DOS session.

What you can do inside Espresso is edit Java classes. In addition to a normal text editing window, Espresso provides a class browser for Java, as shown in Figure 1 (see page 56). The class browser allows you to quickly see and edit the source code for any Java class. In the upper left-hand corner is an alphabetic list of classes. When selected, the pane in the upper right-hand corner fills with a list of the functions and variables of that class. When one of those is selected, the function body or the variable declaration is shown in the lower pane, in which you can edit.

Object-oriented programming is all about programming many small, relatively simple interactions between logical packages of data and function called objects. Objects are specific instances of a logical type called a class (for instance, Jerry Lewis is an object, an instance of the class Human). The Java language comes with hundreds of prewritten classes, which provide a library of ways to deal with windowing elements, graphics, input/output, and Internet connections. A browser such as Espresso's is an important tool for rapidly moving through this large body of source code.

SpinBanner: A Text Effect Applet

You know those signs at train stations that spin through the destinations and times with a whirring and clattering sound, forcing you to look even though you know perfectly well your track and destination time? I wanted to create something similar — a text effect applet that implies breaking news and that gives a Web page a feeling of motion (see Listing 1).

All Web applets inherit from the class Applet. In object-oriented programming, inheritance is how you specify an "is a" relationship between two classes. Just as a human "is

LISTING 1 SPINBANNER.JAVA

```
import java.applet.Applet;
import java.awt.Graphics;

public class SpinBanner extends Applet {
    String message;
    SpinText line;
    Long sleepDelay;

    public void init() {
        message = getParameter("MESSAGE");
        String sleepParam = getParameter("SLEEP");
        sleepDelay = Long.valueOf(sleepParam);
    }

    public void paint(Graphics g) {
        line = new SpinText(message, sleepDelay, g);
        Thread myThread = new Thread(line);
        myThread.start();
        while(line.inBlock() == true); //Loop until painting is done
    }

}
```

LISTING 2 SPINTEXT.JAVA

```
import java.awt.*;

public class SpinText implements Runnable{
    Thread myThread;
    String msg;
    String outStr;
    char spinChar;
    int cols;
    int inSpin;
    long sleepDelay;
    Graphics g;
    boolean inBlock;
    boolean charInSpin[];
    char displayLine[];

    public SpinText() {
    }

    public SpinText(String m, Long sleepDIn, Graphics gIn) {
        g = gIn;
        sleepDelay = sleepDIn.longValue();
        cols = m.length();
        msg = m;
        displayLine = new char[msg.length()];
        spinChar = ' ';
        charInSpin = new boolean[cols];
        for(int i = 0; i < cols; i++){
            charInSpin[i] = true;
            displayLine[i] = spinChar;
        }
        inSpin = cols;
        inBlock = true;
        }

    public void run(){
        inSpin = cols;
        spinChar = ' ';
        g.setFont(new Font("Courier", Font.PLAIN, 12));
        while(inSpin > 0){
                int i;
                for(i = 0; i < cols; i++){
                        if(charInSpin[i] == true){
                                displayLine[i] = spinChar;
                                if(msg.charAt(i) == spinChar){
                                        charInSpin[i] = false;
                                        inSpin--;
                                }
                        }
                }
                outStr = new String(displayLine);
                this.paint(g);
                switch(spinChar){
                case(' ') :
                        spinChar = 'a';      //start with the lower-case letters
                        break;
                case('z') :
                        spinChar = '.';       //roll over to punctuation -- note that we skip
                                              //exclamation pt., quote marks, and some others
                        break;
                default:
                        spinChar++;
                }
                try{
                        Thread.sleep(sleepDelay);
                }catch (Exception e){
                        return;
                }
        }
        inBlock = false;
    }

    public void paint(Graphics g){
                g.clearRect(0, 0, 300, 300);
                g.drawString(outStr, 100, 100);
    }

    public boolean inBlock(){
        return inBlock;
    }
}
```

how to PUT TOGETHER an INTERNET WEB SITE

a" mammal "is an" animal, the SpinBanner program I wrote "is an" Applet, which itself "is a" Panel, and so forth. Don't get inheritance confused with instantiation — although Jerry Lewis "is a" human, he's one specific human, not a general type of person (although if it suited your purposes you might create a subclass of human such as Fund-Raising Comics Who Are Worshipped By The French, which is so tightly constrained that it contains only a single person).

When a class inherits from another, it gets all the functions and data of its superclass(es). Classes descended from Applet have five functions that are commonly overridden: init(), start(), paint(), stop(), and destroy(). The init() function is called when the applet is created and is where you do any one-time initialization. Destroy(), as you might have guessed, is called when the system needs to reclaim the space dedicated to the applet. Start() and stop() are similar, but they're called when the page containing the applet is visited and left. In other words, an applet might start and stop several times without necessarily being reinitialized and cleaned up with init() and destroy().

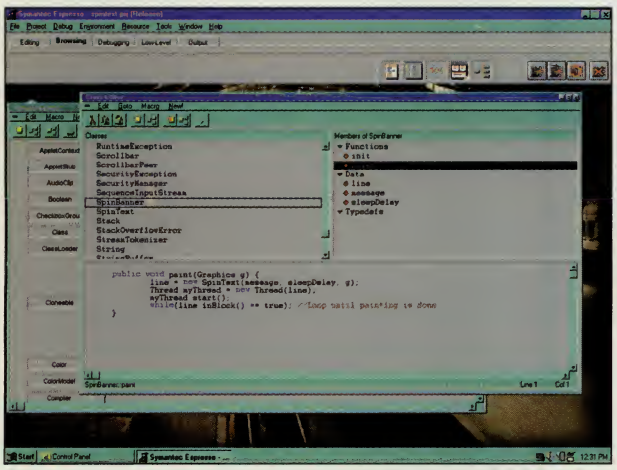


Figure 1. The Espresso class browser allows you to quickly see and edit the source code for any Java class.

In the case of our spinning text applet, we only need to override init() and paint(). First, we declare some variables — *message* contains the complete text of what we want to say, *sleepDelay* contains the delay in milliseconds between flips in the text. Both these variables are passed to the applet as parameter strings and set in the init() function. Note that since sleepDelay is a number, not a string, I have to use a conversion function to set it properly.

The paint() function is called, intuitively enough, when the applet is ready to be painted. Note that it receives a graphics context called g that I pass to the SpinText constructor in the first line of the paint() function. Although SpinText implements Runnable, which is the Java way of saying that SpinText will run in its own thread of execution, when paint() ends, the graphics context passed to paint() goes out of scope and is scavenged. This means you can construct a SpinText with a valid graphics context, call start(), and you'll still have a valid graphics context, but by the time you try to paint to the graphics context, nothing will happen. Debugging this kind of multithreaded problem is a place where Java is, if not harder than C++, at least as hard.

I could've not used a separate thread for the SpinText object, but instead I chose to make sure paint didn't end before I was finished. So, I implemented a blocking semaphore. Let's walk through what happens when SpinBanner's paint() function in Listing 1 — called SpinBanner::paint() to distinguish it from, say, SpinText::paint() — is called.

In the first line, I create a new SpinText object using what's called a constructor. A constructor is a special function that shares the name of the object and that is used for initialization. In the case of SpinText, the last line of the constructor function sets a Boolean variable (that is, a variable that can only be true or false) called inBlock to true.

The next two lines in SpinBanner::paint() create and start a new thread of execution for the SpinText effect. Here's the tricky multitasking thing — the start() function returns control to the main thread of execution almost immediately. Eventually, the Thread object that has now been started will call the run() function in the SpinText object. But if we let the main thread of execution exit the paint() call, the main thread will destroy the Graphics object g before the SpinText object in the MyThread thread ever has a chance to paint on it.

The problem is the same one you get when you receive a telephone call in the kitchen for someone in the living room. You tell them the call's for them, but just because they've said "Okay, I'll get it," doesn't mean you can hang up. You have to wait for them to pick up and tell you, "It's okay, you can hang up now." Not only is the problem the same, but the solution is the same — the last line of paint() is a loop. As long as the SpinText Boolean variable inBlock is set to true, SpinBanner's paint() will never exit and, as long as it doesn't exit, SpinText will be able to paint on the Graphics object g.

Which, as you can see, it does in SpinText's run() function. First, we set a variable called spinChar to the character that will be displayed in the banner, if the banner is not already displaying the correct letter of the final message. Then, we change the font of the Graphics object to Courier, which is monospaced and will therefore neatly place the characters one on top of the other.

Then we enter the main loop of the SpinText effect — we fill up a character array called displayLine with the current spinChar if the corresponding slot in another array, charInSpin, is set to true. If that character corresponds to the message, we set the slot in charInSpin to false, freezing the correct character in place. We paint this string, which contains correct characters and the current charInSpin, on the Graphics object.

We then use a switch statement to roll the spinChar through the characters in a way pleasing to the eye, sleep for the specified delay in milliseconds, and then go to the next spinChar or, if the entire message has been spelled out, exit the loop. The last thing we do is set the inBlock variable to false, which will allow the SpinBanner::paint() function to "hang up the phone" and exit.

The SpinBanner applet is a functional and attractive applet that requires less than three seconds to download over a 14.4kbps modem. To see the SpinBanner applet in action and to download the source code, check out http://ourworld.compuserve.com/ALTnet/. For other great text-effect applets, check out http://www.gamelan.com/.

Eventually Java applications will open up a new world of Web design possibilities, but for the moment, one of their greatest benefits is visually spicing up pages for low-bandwidth connections. Of course, if you could figure out at what speed people were connecting to your site, you'd be able to customize the page to provide greatest visual impact for those with high-bandwidth connections and greatest loading speed for those with low bandwidth. But how can you do that? Java's the key, but the details will have to wait for another time.

ABOUT THE AUTHOR

Larry O'Brien is the conference chair of Web Development '96, editorial director of *Software Development* magazine, and technical director of ALT.net, a custom Web and CD-ROM development house. He can be reached at interactivity@mfi.com.

IF LINGO WERE HTML

GRAY MATTER DESIGN PRINTOMATIC XTRA FOR MACROMEDIA DIRECTOR

BY JIM GASPERINI

This set of crossplatform printing tools, consisting of Lingo scripts and ancillary C code, offers a much-needed supplement to Macromedia Director, which includes only rudimentary page layout and printing capabilities. But "-OMatic," implying "punch a few buttons and the machine takes over," is an overstatement. Taking full advantage of gray matter design's PrintOMatic plug-in requires somewhat sophisticated, and very laborious, use of Lingo.

A script called PrintStyledText makes it possible to create formatted text Cast members and print them. In Director 4.0.4, this takes forever — the software must determine the font and type style of each character individually. (The documentation warns not to use this method except on very small bits of text.) The tools provided for printing bitmapped text work more efficiently, allowing you to print selected portions of the Director stage, Director Cast members, or graphics files from disk. Unfortunately, some scripts fail with PICTs of greater than 8-bit depth on Mac systems set to 16- or 24-bit color, and on Windows systems there's no support at all for PICTs of greater than 8-bit depth. Furthermore, printing bitmapped text isn't much help for applications that ask the user to fill out forms or otherwise customize the text.

For those willing to wade in and mark up every last format change with Lingo script as if it were HTML, PrintOMatic makes just about anything possible — multipage layouts, any combination of fonts or styles, object-oriented graphic primitives, portrait or landscape output, Encapsulated PostScript files, page numbering. Output can be sent to any Mac- or Windows-compatible printer, according to gray matter. Sample scripts supplied in a demo movie make for useful cut-and-paste shortcuts. This spares designers of kiosk applications and CD-ROMs with print-out components the trouble of rolling their own expansions of Director's printing features. Just be prepared for everything to take far longer to prepare and print than it would in a dedicated page layout or word processing application.

Most of these shortcomings will clear up, we're promised, with the release of Director 5.0, in which the clumsy XObject structure will be replaced by Macromedia's slick new MOA architecture, in which plug-ins will be called Xtras. In fact, calling the current version of PrintOMatic an Xtra is jumping the gun — technically it's an XObject. The new architecture promises to simplify life both for third-party creators of plug-ins and for the developers who use them. Rather than waiting, though, gray matter design is releasing XObject versions of their plug-ins and calling them Xtras anyway. A true Xtra version of PrintOMatic is expected by the time Director 5.0 is released and will be supplied free of charge to registered owners. (Those who purchased the software before gray matter began publishing it will need to pay an upgrade fee, as yet unspecified.)

Fully functional test copies are available as shareware via gray matter's Web site. The commercial version ($299) allows unlimited royalty-free use and refrains from printing a footer on every page that reads "printed with an unregistered copy of PrintOMatic."

PROS AND CONS

Pros

Adds a respectably complete set of page layout and printing features to an application that badly needs them.

Cons

Some of the best features require much tedious busywork, at least until Macromedia Director 5.0 is released.

Bottom Line

If you need to enable users to print from Director, licensing this plug-in is a lot cheaper than rolling your own.

PRINTOMATIC

Description

Printing add-on for Macromedia Director.

System Requirements

Macromedia Director 3.1.1 or above for Macintosh or Windows.

Features

Generates multipage layouts with any combination of text and bitmapped or object-oriented graphics; prints styled text in any combination of available fonts, sizes, and styles; prints selected portions of the Director stage, Director Cast members, or graphics files from disk; prints object-oriented graphic primitives, lines, boxes, ovals, and rounded rectangles; portrait or landscape output; multiple linked text boxes can span multiple pages; automatic page numbering; customizable print progress dialog; print preview.

Suggested Retail Price

$299.

Contact

gray matter design, 300 Brannan St., Ste. 210, San Francisco, CA 94107; vox 800.933.6223, 415.243.0394; fax 415.243.0396; Web http://www.gmatter.com; email gmdesign1@aol.com.

Reader Service #161

ABOUT THE AUTHOR

Jim Gasperini's CD-ROM *ScruTiny* in the *Great Round*, an interactive art work created with Tennessee Rice Dixon and published by Calliope Media, won the 1996 Grand Prix du Jury Milia d'Or at Cannes. He is also the author of *Hidden Agenda*, a simulation of Central American politics.

PRODUCT REVIEWS

POWER ANIMATION ON THE MAC

ELECTRICIMAGE ANIMATION SYSTEM 2.5.2

BY RICHARD LAINHART

PRODUCT REVIEWS

Electric Image's ElectricImage Animation System 2.5.2 is considered the ultimate animation program for the Mac both for its features (unparalleled in the Macintosh universe) and its price (guaranteed to keep the riffraff out, to say the least). Electric Image has always identified their competition as 3D software running on Silicon Graphics machines rather than Mac or PC applications, and $7,500 is a pittance compared with pro-level SGI packages such as those from Alias or Wavefront, which can run as high as $50,000 with all options.

Actually, at this point ElectricImage's most direct competition is from Microsoft Softimage NT (see review on page 68). It costs only a bit more and includes the most important capabilities that ElectricImage lacks, namely spline-based modeling. But Softimage NT doesn't yet provide some of ElectricImage's most impressive functions — so we'll have to call it a draw until head-to-head comparison reveals a more detailed perspective.

As for the high-end stuff, what you get for your $50K is software that can do anything in the 3D world — lifelike *Jurassic Park* dinosaurs, realistic hair that ripples in the breeze, mind-blowing special effects a la *Terminator 2*. All this power, though, costs you not only your hard-earned dollars, but many hours struggling up steep learning curves. Sometimes you even need to learn a proprietary programming language to get the job done.

On the other hand, programs like Autodesk 3D Studio and Strata Studio Pro not only cost less than the SGI applications, well under $2,000 in some cases, but also are much easier to learn and use, and they have all the features a 3D animator needs for day-to-day work. Is ElectricImage that much better than programs costing a quarter of its price?

Well, yes. Can it do everything that an Alias/Wavefront package can do? No, but it does most of them, and what it does do, it does faster than anything else out there.

Let's take a look.

Getting Started

ElectricImage 2.5.2 is sold only through authorized dealers, and each copy is initialized for the customer who buys it. In other words, the dealer tells Electric Image who it's for, and the company creates a copy of the program with your name, company name, and serial number embedded. This is the first of several layers of copy protection.

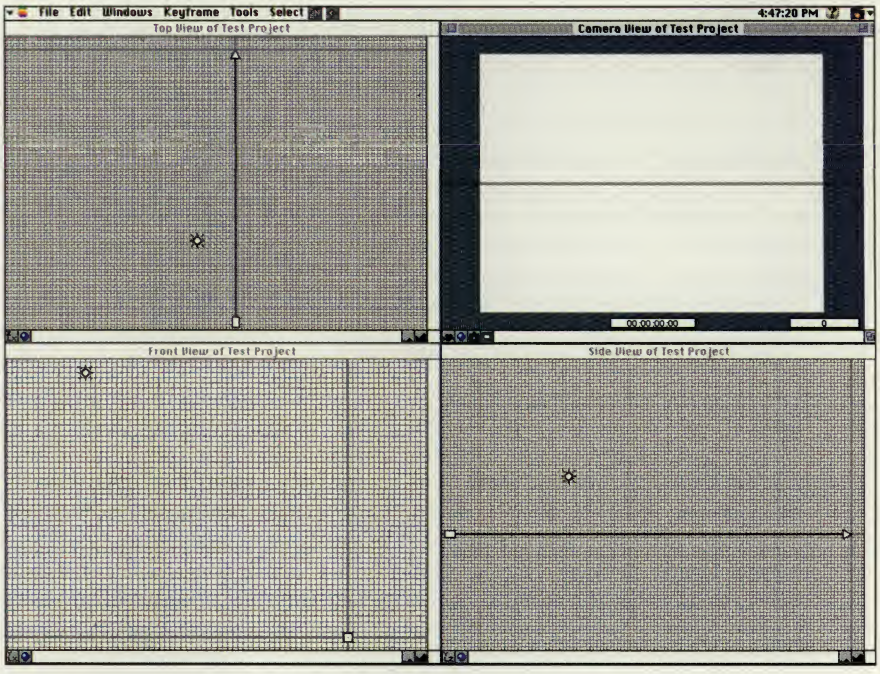


Figure 1. The main screen of ElectricImage Animation System.

The program ships on either floppies or CD-ROM and includes a bulky primary manual and a couple of supplementary manuals. If you don't already have a CD-ROM drive, you'll surely want one because the CD-ROM includes textures, tutorial projects, and rendered images and animations as well as demo versions of related third-party products. You also get some copy protection codes and a dongle (a hardware copy-protection key that looks like a little plastic candy bar with a pigtail and attaches to your ADB port). ElectricImage won't run unless the dongle is installed.

Incidentally, while the manuals do describe every function, the writing can be annoyingly opaque. To whit: "Size. This edit box contains a value for the size of the light" — never mind what the size of a light may mean. Likewise, the six tutorials never bother to explain why they're asking you to perform a given operation — you're simply instructed to enter specific values into various edit boxes without being told what will happen or how to apply what you've done to your own projects. Consequently, working with ElectricIm-

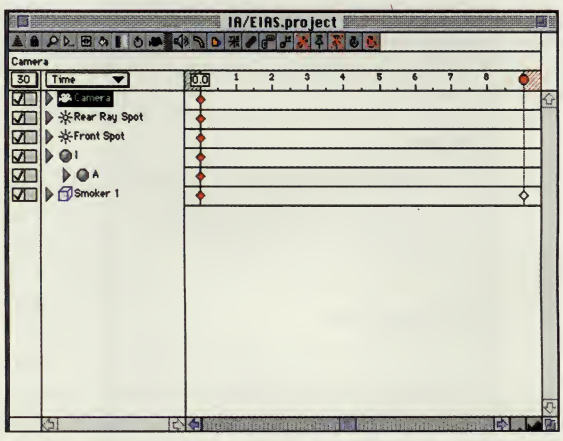


Figure 2. ElecricImage Animation System's PROJECT window.

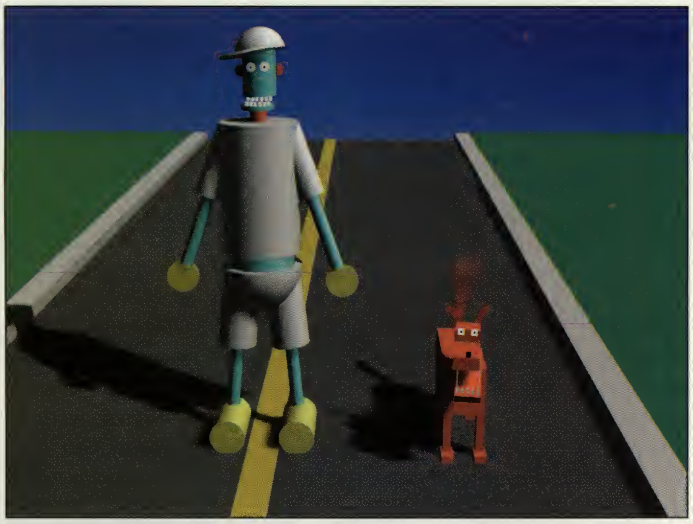


Figure 3. A scene made exclusively with built-in primitive shapes — Primitive Kevin and Cubic the Dog. On a Power Mac 8100/110, this image at 1280x960 pixels rendered in three minutes.

age can involve quite a lot of trial and error — a situation sufficiently pervasive throughout the program that it's well beyond the scope of this article to resolve. (If it's any consolation, the high-end SGI programs generally are no better. Electric Image reports that new manuals are in the works.)

ElectricImage works best with a hefty Mac, at the least a Power Mac with 48MB RAM. It runs on Quadra-level machines with as little as 16MB RAM, and even the non-Power Mac version renders faster than some Power Mac native 3D programs. However, the native Power Mac version renders some five times faster than the non-Power Mac version running on an equivalent CPU, so it's well worth upgrading to a Power Mac if you're going to invest in ElectricImage. Furthermore, ElectricImage is a RAM-hungry program. With only 16MB you'll quickly run out of memory when trying to load or render anything beyond the simplest flying logo. As for monitors, you'll be working with plenty of windows, so you'll want as much screen real estate as you can afford. A two-monitor setup comes in handy (as I'll explain in a moment).

Shut down your Mac, attach the dongle, and reboot — never attach or detach the dongle while the Mac is running as this tends to freeze the system — and you're ready to copy the program to your hard drive. ElectricImage comprises a number of separate modules including ElectricImage, the main application, which itself consists of the program and folders for plug-ins and libraries; Camera, the rendering program; and Projector, where you view rendered files and polish finished animations. There's also a folder of converter applications and Renderama, a separate application for batch and distributed rendering (which requires an individual rendering engine, called Slave Camera, on each machine in the network).

Once you've installed these files, double-clicking to launch ElectricImage initiates the next layer of copy protection: entering the codes (the first time you run the program only). According to the dialog boxes, one of these is an "authorization" code, the other an "expiration" code. In earlier versions, the expiration code provided a date after which the program would cease to function. Electric Image assures that version 2.5.2 has no time limitation.

When ElectricImage opens, it prompts you to create a new *project* or open an existing one. ElectricImage then asks you to locate a model file to add to the project. Once you've added a model (or clicked DONE to cancel the dialog), four windows appear: TOP, SIDE, and FRONT views and a CAMERA view (Fig. 1). The camera and one light source constitute the default elements in a project. The TOP, SIDE, and FRONT view windows show the objects in your scene without perspective. You can zoom in and out of these windows, but you can't change their basic orientation (that is, no orthographic or angled views). Each of the three windows can be set to any view. If you like, you can use them to display three different zooms into the FRONT view. The CAMERA window always shows what the camera sees.

Oddly, the most important window, PROJECT (Fig. 2), must be opened manually. This displays a list of all the elements in your scene and provides access to dialogs that let you modify them and enter timings for animations.

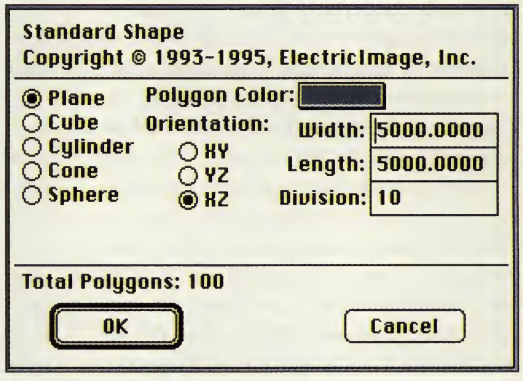


Figure 5. The STANDARD SHAPES dialog.

If you have two monitors, I'd recommend keeping the three view windows and your open tool palettes on the largest screen and the CAMERA or PROJECT window on its own secondary screen. It's easy to drag these windows around to suit the demands of a given project, but unfortunately you can't set the default arrangement for new projects. They always open in the arrangement shown in Figure 1.

Figure 4. A logo rendered from a PostScript font with smoke and light rays. This 1280x960 pixel image took 13 minutes to render. Smoke increases rendering time significantly.

A Career in Modeling

So the program is up and running and you want to make a pretty picture. What's next? Well, you need to make a model (a geometric specification of an object) to render. And where do you do that? Somewhere else, because ElectricImage doesn't include modeling functions. This is a critical weakness — and not only because you need to purchase another program to use ElectricImage. Let's examine why.

The lack of an integrated modeler means that every 3D object (with some exceptions that we'll get to in a moment) must be imported. Imported objects also need to be converted from their original file format to FACT, ElectricImage's own object format, unless your modeler supports FACTs directly, which few do at present. With file conversion and importation comes time spent moving between programs and the possibility that some of your work will be lost in the translation. In the best case — you've built and positioned all your objects as an integrated scene in a single modeling environment, done some surface and texture work in ElectricImage, and then found you need to modify one of the models — you can go back and forth with little trouble beyond the simple inefficiency of using two programs. (However, you do need to do some tricky things such as naming the modified object with the original object's name, which makes it harder than it should be to keep track of different versions of the same model.)

In the worst case — you're assembling the scene in ElectricImage using models built individually, perhaps from a variety of sources — objects must be built apart from the context of the scene, and, after importing, each one must be placed, scaled, rotated, and textured individually. Then, if you need to modify an object's geometry — and you certainly will — you must return to the modeling program, edit the model, save it, go back to ElectricImage and reimport and convert it, and then place, scale, and so on. There's no direct way to replace or edit an object once it's in ElectricImage without losing work you've done in the meantime.

Furthermore, ElectricImage supports only polygonal geometry rather than the spline-based geometry many current modelers use (see "Polygons & Splines" on page 64). Most animation programs that include modeling functions enable you to access splines as animatable functions, so you can push and pull the structural components of an object and animate these changes over time. This is essential for fluid character animation, one of the fastest growing and most in-demand skills in the 3D business. (The program can import spline-based data from Alias Sketch but converts it into polygons in the process.)

In all fairness, ElectricImage does include limited modeling capabilities using primitive, or basic, shapes, and it imports PostScript fonts and makes beautiful 3D text for flying logos without the need to resort to an external program. There's a lot you can do with these simple resources if you work at it — Figures 3 and 4 were created using primitives and PostScript fonts respectively. And it's true that many 3D professionals work with stock or custom 3D models created out of house and never touch modeling software. Finally, the deformation functions that are new with ElectricImage 2.5.2 make it possible to create complex shapes from simple sources like primitives. Nonetheless, all things considered, it's difficult to avoid the conclusion that the lack of an integrated modeler prevents ElectricImage from posing a real challenge to Microsoft Softimage or SGI's Alias/Wavefront packages.

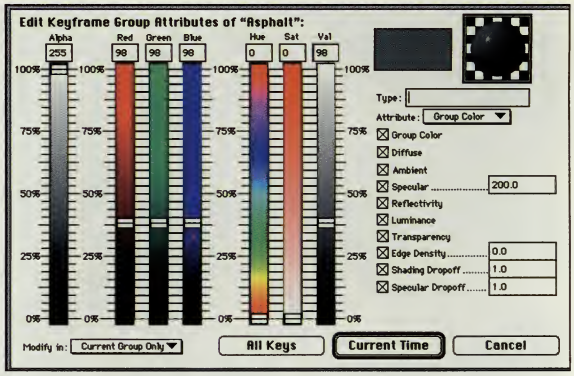


Figure 7. The SURFACE EDITOR window.

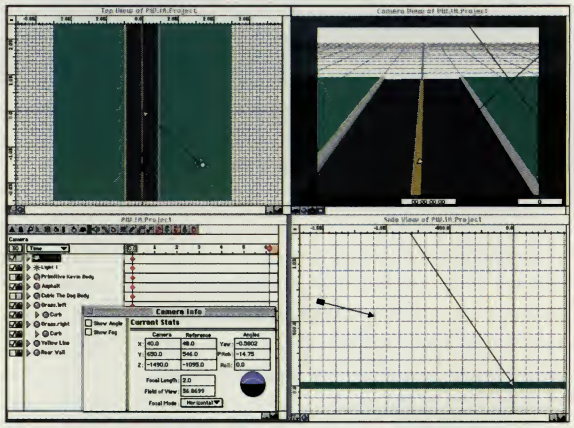


Figure 8. The CAMERA INFO window as well as the PROJECT window, TOP and SIDE views with the camera in position, and the CAMERA window with a shaded view of our scene so far.

Civilizing the Primitive

That said, let's get into what ElectricImage does really well: animation and rendering. To see what the program can do, let's follow the primitives project displayed in Figure 3 from start to finish, working exclusively with the resources ElectricImage has to offer.

First thing first: Create the ground plane to build on. The primitive shapes built into ElectricImage include planes, cubes, sphere, cones, and cylinders. Select FILE>ADD>STANDARD SHAPE... to open the STANDARD SHAPE dialog (Fig. 5) and choose PLANE as the object type, XZ for orientation so the plane lies flat, and set size to 5000 units square. ElectricImage has no absolute or realworld size reference; these units are arbitrary. Click the POLYGON COLOR button to open a color picker and choose a dark gray.

The ground plane shows up in the PROJECT window with the name STANDARD SHAPE. Clicking on the object, hitting the ENTER key, and typing lets us name the object, and hitting ENTER again sets the name. We'll call it Asphalt. Position the object (called a *group* in ElectricImage, whether it's a single piece of geometry or a collection of linked objects) by click-and-dragging it around in any view window. (Note that you can't drag groups in the CAMERA window.) Another way to position a group is to double-click on it either in the PROJECT window or in a view window to open its GROUP INFO window (Fig. 6).

The GROUP INFO window is an important tool for modifying a group's characteristics. Not only can you enter values for position, rotation, and scaling as well as esoteric properties such as motion blur type and anti-aliasing level, you can fine-tune surface properties by clicking the SURFACE button (the shaded sphere in the upper right corner) to open the surface editor (Fig. 7). Here you can set an

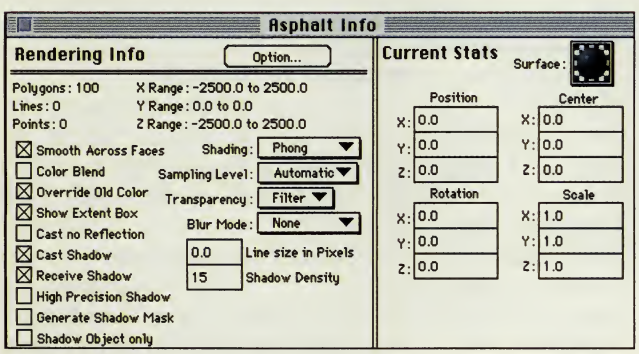


Figure 6. The GROUP INFO window.

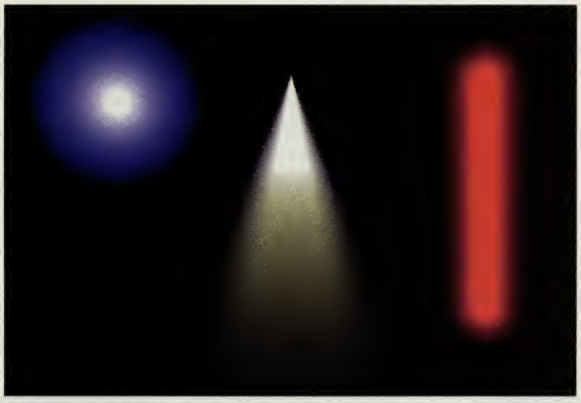


Figure 9. Three types of glow lights: radial, spot, and tube. This 1280x960 pixel image rendered in 1:03.

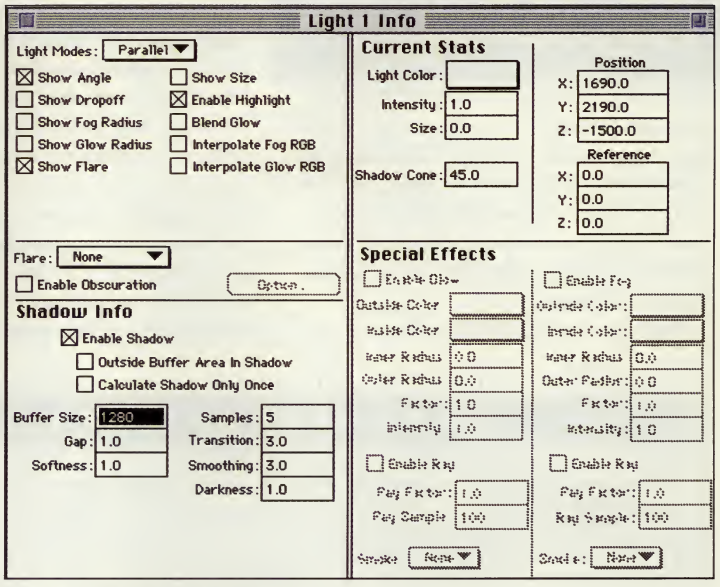


Figure 10. The LIGHT INFO window.

overall group color as well as transparency and reflectivity values. How these functions interact isn't well explained in the manuals, so it's trial and error time again. By the way, all properties in the GROUP INFO window can be animated, which we'll get to shortly.

Following the same procedure, add a group of cubes to create the curbs, grass, and center yellow line that make up our primitive street. Remember to give each group an appropriate color when you create it, and be sure to give it a descriptive name at the same time. Otherwise they'll all have the same default name and you won't be able to tell which is which. Each cube is as deep as the Asphalt group, 5000 units, but narrower and of varying heights. In this case, the grass groups are 5000 units deep, 2000 wide, and 50 high. The curbs are 5000 by 50 by 50, the yellow line is 5000 by 40 by 1. By switching between TOP and FRONT views, zooming in and out, and scrolling as necessary, drag these groups into position and line them up accurately. To zoom into view windows, click on the zoom icons (the mountains) in the lower right corner of each window or hold down the OPTION key and drag the cursor across the area you want to zoom into. You can also select the magnifying

MULTIPLE CAMERA PATHS IN A SINGLE PROJECT

ElectricImage has only one camera, and you can save only one camera position at any one point in time. (Multiple cameras are on the drawing board for a future update.) If you want to edit among several versions of a camera fly-through, for instance, you need to save different versions of the project. This gets to be a problem if you start changing elements in the project itself, because then you have to update alternate versions of the project as well.

However, you can save different motion paths for the camera using a new 2.5 feature called *effectors*. Effectors are null objects (that is, objects that don't render) to which you can attach other objects. For example, you might attach a number of planets to a central effector and animate the effector's rotation so the planets rotate without the need to animate each one individually. An unlimited number of effectors can be placed in a project. By using them as placeholders for camera paths, you can have an unlimited number of camera paths in a single project. Here's how to set it up.

Set the project to keyframe or time mode by selecting from the pop-up menu at the top of the project window. Set the current frame to 0 or drag the TIME SELECTOR to 00:00. Select the camera in the PROJECT window and double-click it to open the CAMERA INFO window. Choose FILE>ADD>EFFECTOR, then click in any view window to place the effector (it's usually easiest to do this in the TOP view). The effector's INFO window will open. Leave it that way. To use an existing effector, double-click it in the PROJECT window to open its INFO window. Drag it to exactly where you want its initial position to be. Its Y rotation should be set to 0. If you're using an existing effector, it may already have a Y rotation. In this case, leave the existing setting.

Select and copy the effector's X position value and paste it into the camera's X position and X reference fields. Do the same for Y and Z position values. Now change the Z reference value to a value one higher than the position value. That is, if the Z position is -43.21, the Z reference should be -42.21. If the Z position is 43.21, the Z reference should be 44.21. This gives you a camera arrow one unit long so you can see where the camera is pointing. The camera should be pointing due "north" at this point. If you find you need a longer camera arrow for visibility's sake, increase the Z reference offset accordingly.

If this is a new effector or the effector's Y rotation is 0, just link the camera to the effector by selecting the camera, clicking on the LINK button in the PROJECT window's toolbar, and then clicking on the effector. If the effector has a Y rotation other than 0, set the camera's yaw angle to a negative version of the effector's Y rotation. That is, if the effector's Y rotation is -55, set yaw to 55. If the effector's Y rotation is 30, set yaw to -30. Because yaw rotates the camera head, you need to rotate the camera head in a direction opposite to that in which you want the reference to point. Then link the camera to the effector. Finally, lock the camera by clicking the box marked by the lock icon in the PROJECT window.

Now you can rotate and position the effector as you like and the camera will follow along. Establish an animation path by setting keyframes for the effector rather than the camera. To make and save a new path, unlink the camera from the old effector, create and place a new effector, and follow the steps above. It's a good idea to name each effector specifically to keep track of its function in a project.

glass tool from the TOOL palette and zoom in and out with that; open the TOOL PALETTE by selecting it from the WINDOWS menu. Next, set each group's color through its GROUP INFO window. Note that colors set in the surface editor override the group's native color set in the STANDARD SHAPES dialog.

Watching the CAMERA window, drag the camera around until the scene is framed nicely (in this example, the camera is positioned above the street, looking down and toward the rear). The camera consists of the camera head (the cube) and its reference (the arrowhead, indicating what direction the camera is looking toward), visible in Figure 8. Each can be dragged independently. Double-clicking the camera in the PROJECT window opens the CAMERA INFO window, where you can enter numeric values for the camera and reference as well as adjust the focal length and field of view.

You'll also notice the light in the scene, which serves in this case as our sun. Lighting is one of ElectricImage's strong points — it's the only program for the Macintosh, and one of few for any platform, that provides visible lights. And they are beautiful — check out Figure 9, which illustrates three types of visible glowing light. As you might expect, double-clicking the light in the PROJECT window opens the LIGHT INFO window (Fig. 10).

Here we've set the light to cast a shadow. In a Phong rendering system (see "Phong

RENDERING WITH PIXEL PRECISION

3D artists producing imagery for multimedia often need to render objects to an exact pixel size in the final image. For example, a common image in CD-ROM games is a control panel with an inset video screen for displaying superimposed QuickTime movies. A variation on this idea is a rendered living room scene containing a television set that displays QuickTime "newscasts" that relate clues to the player. The illustrated screen, of course, must frame the QuickTime image exactly. Usually in these situations, the entire image needs to be 640x480 pixels for full screen display, while the inset video screen needs to be exactly 320x240 pixels to frame the QuickTime clip properly.

Since ElectricImage's CAMERA window can be resized arbitrarily and lacks a ruler marked in realworld increments, it can't be calibrated to a particular pixel size. That is, what appears within it is relative to the final render size, which you set in the RENDER dialog. Thus, there's no way to know if the TV set in your living room scene will render at precisely the pixel size you need — no way, that is, unless you follow the following steps to make a rendering template.

We're going to draw an outline of a black box placed precisely where the TV screen ought to go. Then we'll display it in ElectricImage's CAMERA window and move the camera until the object to be rendered fits within the borders of the box. This way, we know it will render at exactly the right size.

You'll need Adobe Photoshop (an essential tool for multimedia producers in any case) with the ElectricImage Format plug-in, which comes with ElectricImage, installed. This enables Photoshop to export Image files, Electric Image's own bitmap file format. If you're running ElectricImage 2.5.2, you can use PICTs instead of Image files. For this example, let's assume you need to render a 640x480 pixel image with a 320x240 inner screen, as described above.

In Photoshop, create a new file of 640x480 pixels — the basis of the rendering template — and set the CONTENTS to WHITE if necessary. In the tools palette, set the foreground color to white and the background color to black. Make sure rulers are turned on (WINDOWS>SHOW RULERS) and units are set to pixels (FILE>PREFERENCES>UNITS). Double-click the line tool to open its OPTIONS palette and set its width to two pixels; then draw straight, black lines around the edges of the template. This simply defines the edges of the template, and is not essential.

Double-click the marquee tool to open the MARQUEE OPTIONS palette and set SHAPE to RECTANGULAR, STYLE to FIXED SIZE, WIDTH and HEIGHT to 324 and 244 pixels respectively, and FEATHER to 0. Now, in the image window, use the rulers to line up the crosshair cursor at 320 pixels horizontally and 240 pixels vertically. Hold down the OPTION key (which centers the marquee wherever you click) and click. This puts the area to be rendered precisely at the center of the image. If you need the TV screen to be located somewhere other than at the center of the frame, click elsewhere, but be sure to note the position on the rulers — you'll need to click in exactly the same spot again later. Now hit the DELETE key to delete the selected area (revealing the black background), and choose NONE from the SELECT menu to de-select the selection.

Back in the MARQUEE OPTIONS palette, set the WIDTH and HEIGHT to 320 and 240 pixels, leaving the other settings. Back in the template, hold down the OPTION key, and, watching the rulers, click on exactly the same point you clicked on before — 320x240, if you were following the directions. (You may need to hit RETURN to reactivate the rulers.) Your new selection marquee should be inside the black area with a two-pixel border all around. Fill this selection with white by choosing EDIT>FILL...>FOREGROUND COLOR and choose SELECT>NONE to remove the marquee. You should now have a white area outlined with black, the inner dimensions of which are exactly 320x240 pixels. Save this template as either a PICT file (for ElectricImage 2.5.2) by choosing FILE>SAVE AS... or as an Image file (for any ElectricImage version) by choosing FILE>EXPORT>ELECTRICIMAGE....

Now open your ElectricImage project — complete with TV screen — and open the RENDER CONTROL dialog (FILE>RENDER...). In the dialog, click the BACKGROUND IMAGE button to open the BACKGROUND dialog. In this dialog, click in the BACKGROUND window, which calls a standard OPEN dialog. Locate the template file and click Open.

Back in the BACKGROUND dialog, click the SHOW IN CAMERA VIEW checkbox and click OK. Next, make sure your render resolution is 640x480 pixels. Close the RENDER CONTROL dialog without clicking OK. Now you should see the template box in the CAMERA window. Because the background image is drawn relative to current size of the CAMERA window, the area inside the template box will appear smaller than its actual size. Nonetheless, that area will render at 320x240.

Now adjust the camera position so the TV screen fits just inside the template box. Remember to disable the background image before the final render.

Shading vs. Raytracing" on page 65), lights must be enabled to cast shadows because shadows are calculated separately for each light. A *parallel* light, which we've chosen for this example, simulates light coming from a distant source such as the sun. Other light types include *radial* (which distributes light in a spherical pattern, like a light bulb), *spot* (which simulates a focused spot with a variable width beam), *camera* (a non-shadow casting light attached to the camera to illuminate whatever lies in front of it), *ambient* (a directionless light that increases overall illumination), and *tube* (for simulating neon and fluorescent sources).

The LIGHT INFO window also provides access to special effects unique to ElectricImage. These include the glow effects seen in Figure 9 as well as *fog, light rays* (sometimes called volumetric shadows), and *smoke*. The latter can be animated and generates extraordinarily realistic smoke effects, as you can see in Figure 4.

According to Electric Image, the number of lights in a project can total up to 4,000,000 if you have 2GB RAM. Since the absolute maximum amount of RAM you can stuff into any Mac these days is 768MB, this claim is somewhat specious. Electric Image's number isn't a test result but an extrapolation based on the amount of memory a single light requires — so we'll have to take their word for it. Anyway, you can have an enormous number of lights.

Moving right along, it's time to tackle Cubic the Dog, who is made up entirely of cubes of various shapes and sizes. (In ElectricImage, a cube is any six-sided rectilinear figure, not necessarily a strictly cubical form in which all sides are the same size.) We'll start with Cubic's body, since we'll be attaching his extremities to it.

Parental Guidance

After creating the body cube, add four identical cubes for the legs and position them at the bottom corners of the body cube. At this point, the leg cubes have no relationship to each other and if we drag the body cube around, the legs stay put. We need to attach the legs to the body and beyond that, set up a relationship between these elements so the legs bend at the right place and otherwise act like legs.

This introduces the concept of *parent/child relationship*, an important one in ElectricImage. To create this kind of relationship, select the body in the PROJECT window. Either in the PROJECT window tool strip or in the TOOL window, click on the LINK TO PARENT tool (it looks like two interlocking links of a chain). Then click on one of the legs. This links the leg to the body, and you'll see its name indented under the body name in the PROJECT window. This makes the leg a child of the body, which is its parent. Children can have their own children, so you can set up some pretty complex object hierarchies. Once a leg is linked to the body, dragging the body drags the leg as well. Then you're ready to add a foot and make that a child of the leg (Fig. 11).

Having created a functional leg, it's time to determine how the new joint between leg and body will behave. To do this, you select the leg in the PROJECT window and click on the GROUP LINK tool (the XYZ icon) to open the GROUP LINK window (Fig. 12). Here you set the location of the rotation center, or pivot point, of the leg and how the leg behaves when moved. In this case, we want the leg's rotation center to be at the top of the group where it joins the body. We want the joint to act like a hip, so select SOCKET as the link type, which constrains the movement of the leg at the joint in the manner of a hip socket.

Note the edit boxes on the right side of the GROUP LINK window. This is where ElectricImage's new *inverse kinematics* feature resides. Inverse kinematics (IK) makes it easier to simulate natural movement among parts linked in a parent/child relationship. Basically, IK enables objects lower in the parent/child hierarchy to affect objects higher up. A properly configured IK link makes it possible to pull on a figure's foot, for example, and have the lower and upper legs follow naturally. The beauty of this is that you don't need to animate each leg component individually. The IK features are unusually well documented in the ElectricImage 2.5 manual addendum, so they're not difficult to figure out.

A complete human anatomy library — that

PRICE BREAK FOR STUDENTS

Electric Image recently released ElectricImage Scholastic Edition ($795 for registered students). Scholastic Edition is a somewhat limited version of the full program. It doesn't include some higher-end production features such as motion blur, high-res textures, network and batch rendering, variable resolution anti-aliasing, and high-definition shadows. Most important, it renders at a maximum of 512x384 pixels, less than full video resolution, and its project files can't be opened in the full-blown version of ElectricImage, so you can't use the cheaper version as an additional production station in a professional environment.

However, 512x384 is good enough for many kinds of multimedia production, and you do get most of ElectricImage's professional-level animation tools and special effects, including inverse kinematics, effects plug-ins such as Mr. Nitro, light effects, sync sound, and so on. Furthermore, it provides a way for students to develop expertise that can pay off handsomely in the job market. (Reportedly, Electric Image plans to offer a service to put up-and-coming ElectricImage artists in touch with potential employers.) All told, Scholastic Edition is a fine introduction to the full program and a welcome addition to Electric Image's product line.

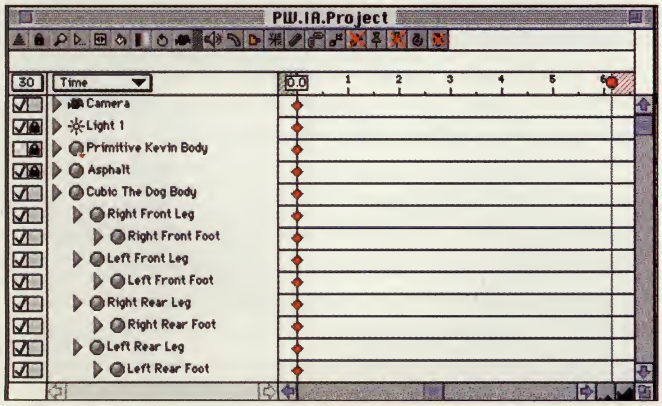


Figure 11. The PROJECT window showing links and parent/child hierarchy.

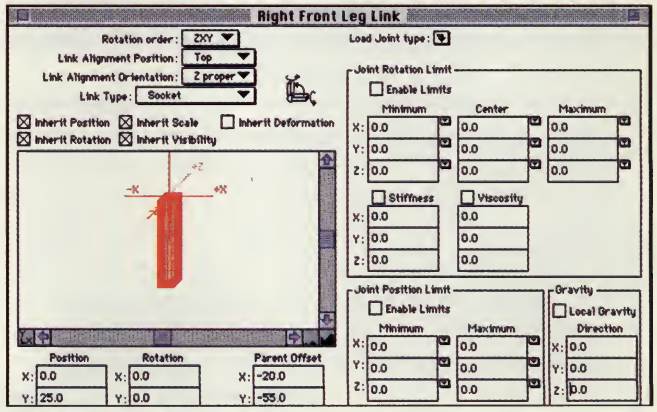


Figure 12. The GROUP LINK window.

is, a preset collection of links and rotation limits — is built into the program in the form of a pop-up menu. This makes it easy to set up IK links in human figures. For instance, you might select a forearm that's been linked to an upper arm, click on the JOINT TYPE pop-up, and select Elbow. This prompts ElectricImage to load the elbow preset specifying a hinge joint that bends only in one direction. The human library is the only one included, but if you want a lizard library, you can set it up yourself and use it for any lizard projects that come along.

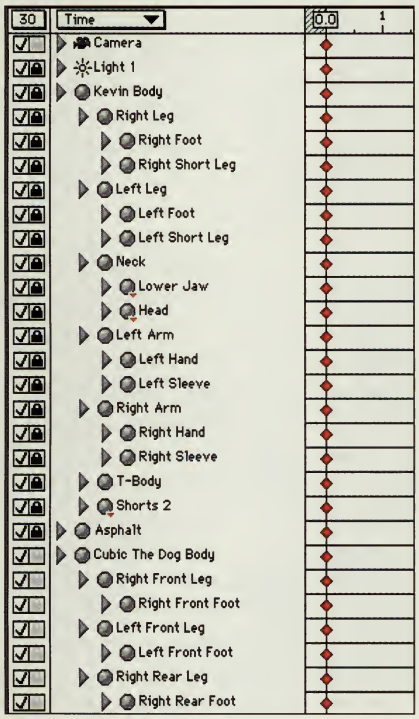


Figure 13. The final character hierarchy.

IK isn't necessary for a cartoonish figure such as Cubic the Dog. Indeed, it isn't necessary for convincing character animation — Pixar's phenomenally successful animated movie *Toy Story*, for instance, was created without IK. Nonetheless, it's an important addition to the animator's arsenal.

I'll leave the rest of the character construction to you and skip ahead to animation, ElectricImage's strong suit. (To finish Cubic, retrace the steps we've already covered. As for Primitive Kevin, he's composed mostly of cylinders. Conceptually he's pretty simple, although tedious to put together — building models is never easy. The final hierarchy appears in Figure 13. Some elements, mostly teeth, are collapsed to save some space.)

Extra Texture

First, though, there's one final element to add: the rear wall, another simple cube. Let's give this one a bitmapped texture for realism (not that realism is such a priority here in Primitive Town). After placing the wall at the rear of the scene, select it and click the GROUP TEXTURE button in the PROJECT window's toolbar — the one that looks like a file icon partly obscuring a sphere. This opens the GROUP TEXTURE window (Fig. 14).

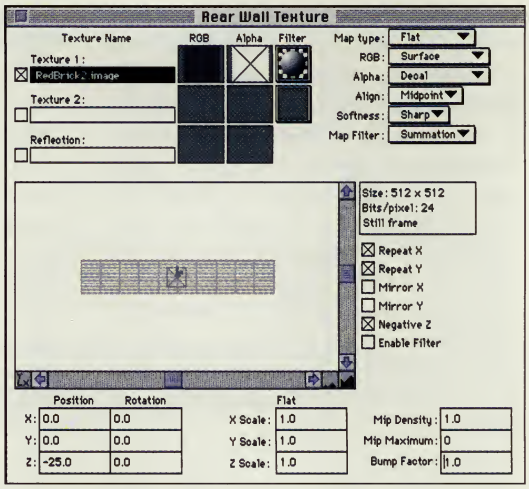


Figure 14. The GROUP TEXTURE window.

The GROUP TEXTURE window is where you cover a group's surface with a bitmapped image. Numerous third-party libraries of scanned or painted textures are available on CD-ROM, one of which was the source for the brick texture pictured here. A scanned realworld photograph can add significant realism to modeled objects. It can even save you the trouble of putting all the necessary details in the model itself. This capability, known as texture mapping, is supported by most 3D programs.

ElectricImage supports two textures per group, letting you do things like apply a basic texture and superimpose, say, a label, a rust spot, or a paint drip. You can even use an animation sequence as a surface texture. Unfortunately, you can't animate any of the set-

POLYGONS & SPLINES

Until recently, almost all 3D modeling programs worked with polygonal geometry exclusively. With this method, object surfaces are described as groups of two-dimensional planes — usually triangles or quadrangles, but sometimes more complex shapes. The math required to describe a shape in terms of polygons is pretty simple, which is why polygonal geometry is so popular. But, as you can imagine, flat shapes don't lend themselves to describing curved shapes.

A cube is defined easily as six square planes, but a sphere requires numerous polygons arranged into a shape that, at best, approximates a sphere. The more polygons you use to describe the sphere, the more closely you can approximate the proper shape, but you'll never create a smooth curve by arranging planar polygons. The more closely you view such a shape, the more obvious its straight edges become. And, of course, the more you increase the resolution of your shape by increasing its polygon count, the more memory and CPU power it takes to push those polygons around.

Splines (variable curves) are a relatively new way to describe complex, organic geometry, defining curves as mathematical formulas rather than a collection of planes. NURBS (Non-Uniform Rational B-Splines) are a refinement of basic splines that are used in a number of newer modeling programs. Because a NURBS shape is a formula, it has infinite resolution and can be drawn smoothly at any zoom factor. Spline math is considerably more complex than polygon math, so spline technology is less common at this time, although acceptance is increasing. Of course, if you send a spline-based model from one program to another, the second program needs to understand spline math to interpret the model correctly.

The difference between polygons and splines can be likened to that between Adobe Photoshop and Adobe Illustrator. To define an image, Photoshop uses a finite number of bitmapped pixels (equivalent to polygons in this analogy). You can zoom into such an image only so far before you see individual pixels rather than the picture as a whole. Illustrator uses 2D PostScript splines (much like NURBS) to create an image at any resolution. However, your output device needs to understand PostScript to render the Illustrator file.

PHONG SHADING VS. RAYTRACING

One of the reasons for ElectricImage's amazing rendering speed is that it uses Phong shading rather than raytracing, the rendering method implemented in many other 3D programs. Without going into enormous detail, Phong shading renders the shading of a surface by calculating the color of an individual polygon based on its surface textures and lighting parameters and then smoothes the surfaces of adjacent polygons to create the final image.

When it's set up properly, the Phong method creates very realistic images. Happily, ElectricImage's Phong renderer is tweaked to let you create good-looking results with ease. Phong's main limitations are that it doesn't calculate reflections and refraction, the bending and distortion of light as it passes through a transparent object. To create these effects in ElectricImage, you have to fake them with texture maps.

Raytracing is a completely different method based on the physics of light. Surfaces are calculated by tracking virtual rays of light throughout a scene as they bounce off objects (reflection) or pass through objects (refraction), based on their surface characteristics.

The advantage of raytracing is that shadows, reflections, and refractions are calculated automatically as part of the process, so it's generally better for creating photorealistic images. The main disadvantage is that the computer must calculate what can amount to millions of virtual light rays bouncing around in the scene. This makes raytracing generally much slower than Phong shading, which is why the latter is the preferred method in rendering-intensive fields such as television and film.

tings in this window and GROUP TEXTURE doesn't provide much indication of how the final result will look. So it's up to trial and error once again, placing the textures and rendering test shots to see how they come out, returning to the window, remapping, rendering, remapping, *ad tedium*. Happily, Electric Image has announced that they intend to support Apple's QuickDraw 3D technology, which provides realtime feedback while mapping textures, among other things. They also intend to increase the number of textures per group and add animation for texture settings in a future update.

To keep things simple, set up this map to tile across the surface of the wall. (Keep in mind that the texture displayed in Figure 15 is designed to tile more or less seamlessly.)

Soon To Be a Major Motion Picture

Now we're ready to make things move. In ElectricImage, as in many animation programs, animation is based on keyframes. In the old days of hand-drawn cel animation, the head animator didn't draw every frame. He drew only the most important, or key, frames. Assistants known as in-betweeners drew the remaining frames in between. With ElectricImage, you're the head animator and the computer is the in-betweener.

The basic procedure is to set the starting position for a moving object (which may be the camera, light, or model group), move the time counter to the next key position, move the object to its new position, move the time counter again, and so on. ElectricImage calculates and interpolates positions between keyframes and fills them in when the final animation is rendered.

Consider a simple five-second animation in which the camera zooms in on the characters while moving to the side to focus on the dog, whose tail wags and whose head turns to follow the camera. First, set the initial camera position for the first frame. With the TIME SELECTOR set to 0.0, the first frame, move the camera to its correct position (Fig. 16 — Primitive Kevin has been turned off to keep things simple). Now move the TIME SELECTOR to 5.0 (that is, five seconds) and position the camera for its final frame (Fig. 17).

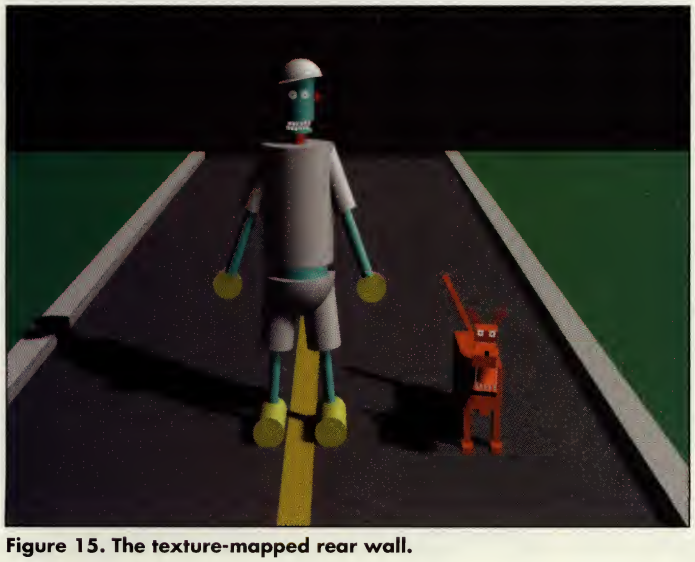


Figure 15. The texture-mapped rear wall.

Note the blue handles on the motion path. Motion paths are editable 3D splines, and the handles enable you to drag them into virtually any shape you want. For this example, we'll drag the handles to smooth the motion as much as possible and keep the camera and reference paths parallel (Fig. 18).

Next we want to modify the

Figure 16. The first frame of the example camera animation.

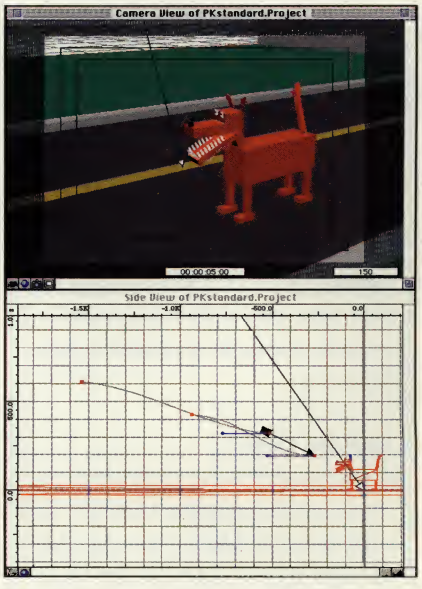


Figure 17. The final frame of the example camera animation.

camera's velocity to reflect more accurately the way a real camera moves. In the real world, objects don't progress from a standstill to motion instantly; some acceleration is necessary before the object reaches full speed. By the same token, realworld objects don't come to an instant stop; inevitably they slow down first. The CAMERA VELOCITY window lets you change the camera's velocity to reflect these constraints. To make the camera come to a smooth, gradual halt as it moves in, select the camera in the PROJECT window and choose WINDOWS>CAMERA VELOCITY to open the CAMERA VELOCITY window (Fig. 19). Now drag down the velocity graph for both the camera and reference at the final keyframe. This causes the camera to decelerate gradually over the course of the animation.

Just a few more steps and we'll be ready to render this baby. The first one is easy. We want the dog to look at the camera as the camera moves in. Fortunately, ElectricImage has a feature called LOOK AT OBJECT for just this purpose. Set the TIME SELECTOR back to 0.0 and select the dog's head in the PROJECT window. Then click on the LOOK AT tool in either the PROJECT window's toolbar or the TOOL palette — it's the arrow pointing at a sphere. Click on the camera and ElectricImage calculates the custom frames necessary for the dog's head to track the camera. Figure 20 gives some indication of the result: The dog appears to be looking at the camera throughout the animation.

Let's get the tail wagging and we'll be done. Set the PROJECT window to keyframe mode by clicking on the pop-up menu at the top of the window. This displays the individual frames in the animation with keyframes indicated by a key icon. Still at FRAME 0, double-click on the dog's tail to open its INFO window and set Z ROTATION to 25 degrees. Now go to Frame 3 by clicking on the cell numbered 3 at the top of the PROJECT window and set the tail's Z ROTATION to -25 degrees (Fig. 21). This makes for a pretty fast wag; the tail moves from left to right in about 1/7 of a second.

Click on the key icon at FRAME 0 and drag over to the key icon at FRAME 3 so that all four cells in the row are selected (Fig. 22). Finally, click on the CYCLING pop-up menu in the PROJECT window's toolbar (it looks like a looping circle) and select OSCILLATE. This will make the four frames loop back and forth throughout the animation so we don't have to set the keyframes manually — a tremendous timesaver. If you're in a mood to get fancy, you might want to set the tail's BLUR MODE (in its INFO window) to MOTION VECTOR. This blurs only the tail as it moves.

Ready to render? Select FILE>RENDER... to open the RENDER CONTROL window (Fig. 23). This provides all the rendering options for final output including how many frames to render (all, in this case), a background image to fill in areas not covered by 3D objects (I selected a sky-like gradient), render size and quality (video resolution, best quality), and blur functions. For the example, I've selected a MOTION VECTOR blur. We could use a MULTI-FRAME blur for this render, but since this would render four frames and then average them throughout the animation, rendering would take four times as long. When you're ready, click Go. ElectricImage asks where you want to save the file and then quits and launches Camera, the rendering application.

ElectricImage boasts very fast rendering times — in fact, it's touted as the fastest renderer on any platform. This is difficult to quantify because it's impossible to recreate precisely an ElectricImage project (or any program's project) in a different program, but ElectricImage is incredibly fast. At video resolution, these frames render in less than two minutes apiece on a Power Mac 8100/110 — and it's significantly faster than that on the current PowerPC 604 Power Macs. The rendering quality is beautiful, as you've seen. Very few programs, if any, give you this kind of quality coupled with this kind of speed.

Conclusion

These exercises only scratch the surface of ElectricImage 2.5.2. There's a lot we've glossed over: object deformations (which

PROS AND CONS

Pros

Fast, high quality rendering; excellent special effects.

Cons

High price, requires an external modeling program, inadequate documentation, lacks raytracing.

Bottom Line

ElectricImage is the best professional animation production tool for Macintosh, but a little limited for character animation compared to the best systems on the Silicon Graphics platform.

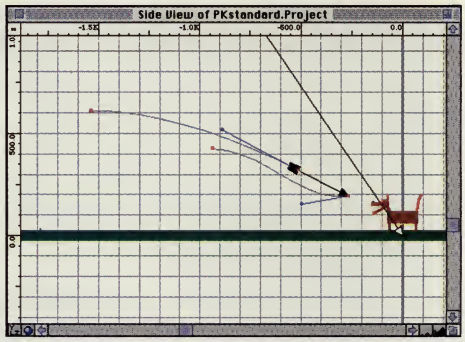


Figure 18. Tweaked camera motion paths.

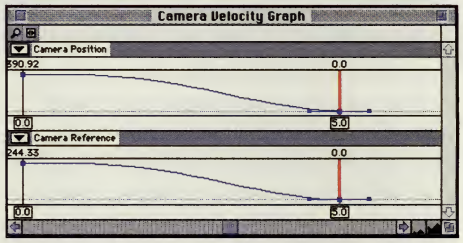


Figure 19. The CAMERA VELOCITY window, with velocity adjusted.

Figure 20. The dog's head tracks the camera after applying LOOK AT OBJECT.

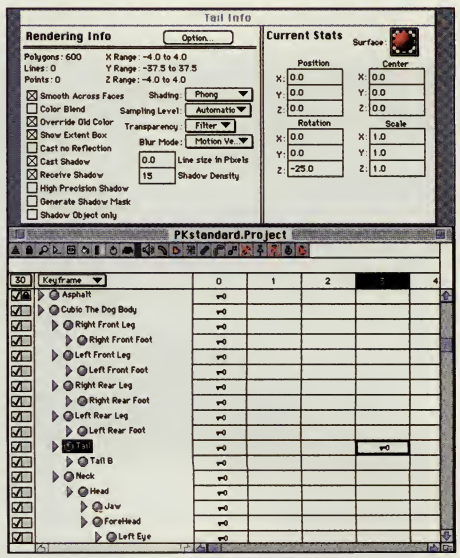


Figure 21. The PROJECT window in keyframe mode, with the tail selected and its INFO window open.

ELECTRICIMAGE ANIMATION SYSTEM 2.5.2

Description
Professional 3D animation and rendering application for Macintosh and Power Macintosh.

System Requirements
Macintosh Quadra or better; System 7.5 or later; QuickTime 2.0 or later (for optional QuickTime support); 32MB RAM, 24-bit color, large-capacity hard drive. Recommended: Power Macintosh, 64MB RAM, CD-ROM drive.

Features
Fast Phong rendering; still or animation rendering at resolutions greater than 16,000x16,000 pixels; field rendering; six fully animatable light types (radial, ambient, spot, parallel, tube, camera); visible light sources (with shadows, glow, fog, light rays, smoke); animatable lens flares; three types of motion blur; 3D inverse kinematics (multiple links and linkage types, rotation limits, stiffness controls, gravity awareness); effectors (null objects); batch and network rendering support; high quality anti-aliasing (oversample and adaptive types, variable anti-alias and sampling levels per object or per project); 3D Bezier motion paths; sound file import for sync sound; object deformations (scale, shear, twist, taper, bend, bulge, linear wave, circular wave, stretch, Bezier warp); animation vibration effects (randomize, jolt, spring); input/output gamma control; physics-based explosions; particle systems; blobs (basic metaballs); primitive shapes (plane, cube, cylinder, cone, sphere); object meshing; supports 30 3D model formats; creates 3D fonts from PostScript fonts; supports third-party plug-in software extensions.

File Support
FACT (native geometry format), Alias Sketch Styleguide Export, Architron II, Autodesk 3D Studio, Cad-3D, Cubicomp, Cyberware, DXF, Dynaware, Filmroll, Generic, Lightwave, MacConcept, Mac 3D Text, Movie.BYU, MPS Demo, OFF (.geom), OSU (.DETail), Phoenix 3D, Sculpt 3D, Super 3D Text, Swivel 3D, TWGES, Videoscape, Wavefront .OBJ, Zing, Zoom, 3D Turbo, 3DGF Binary, PostScript font, Image (native bitmap format), QuickTime, PICT, AIFF, OMF.

Suggested Retail Price
$7,495. Slave Camera engine for distributed rendering $1,495. Scholastic Edition $795.

Contact
Electric Image, 117 E. Colorado Blvd., Ste. 300, Pasadena, CA 91105; vox 818.577.1627; fax 818.577.2426; Internet support@electricimg.com.
Reader Service #162

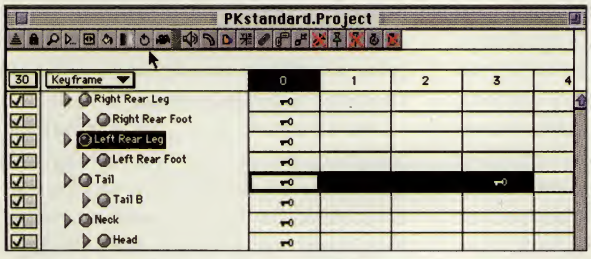


Figure 22. The first four frames selected. The cursor points at the CYCLING pop-up menu.

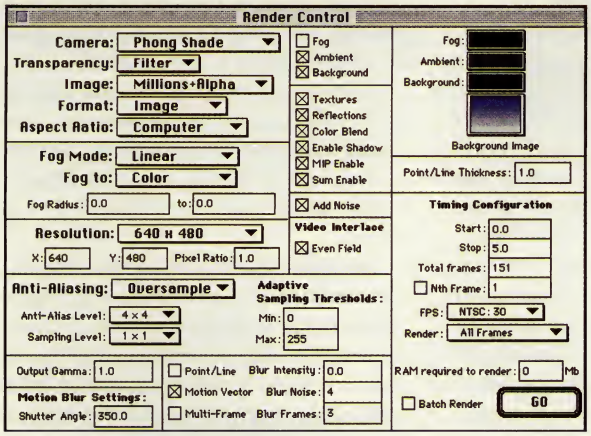


Figure 23. The RENDER CONTROL window with options set.

let you warp and distort objects in various ways over time), explosions (for blowing models up, with accurate physics and texture mapping on individual polygons), particle systems (to simulate water, fire, and dust), pseudo-metaballs (which makes it possible to blob objects together like flowing mercury), fog and smoke effects (for depth cueing plus animated smoke and clouds), animation vibration effects (to jolt and bounce objects or the camera), field rendering (for the smoothest possible motion when outputting to video), 3D lens flares, and multi-frame motion blur (both of which help simulate the look of real film photography.)

These features allow you to create spectacular special effects as well as increase productivity. Ultimately, though, ElectricImage's greatest strength is the speed and quality of its rendering, and it's for this reason that, among Macintosh 3D programs, ElectricImage alone is a fixture in feature film production and broadcast video (not to mention interactive studios and game developers).

The lack of an integrated modeler is a severe limitation. Modeling programs that serve as a suitable complement include auto.des.sys form.Z, with its precise and flexible solids modeling, and Yonowat's Amapi, for modeling fluid organic shapes, both of which export FACT files. Be that as it may, ElectricImage really ought to have its own internal spline-based modeler.

So equipped, it would pose a serious threat to even the highest-end applications — it's very nearly there already. For example, I just finished a project in ElectricImage involving a 3D environment that comprised more than two million polygons, 5,000 objects, and 1,000 texture maps. No other Mac program can even open a project like this, much less render frames in fewer than six minutes apiece. Even most SGI programs couldn't handle a project of this size. I've heard of ElectricImage opening and rendering projects that SGI's Alias couldn't open on an Indigo II Extreme, a system costing over $60,000 for both hardware and software.

Sure, it's costly. But ElectricImage is a professional production tool, and professional tools seldom come cheap. For animation professionals, there is no better Mac-based animation tool.

ABOUT THE AUTHOR

Richard Lainhart resides in New York where he uses the Macintosh to make sounds and images. He spent the past year working on the *All Access HORDE Festival* CD-ROM for Philips Media, and boy, is he glad that's over.

PRODUCT REVIEWS

ANIMATION BANG FOR THE BUCK BONANZA

SOFTIMAGE 3.0 FOR WIN NT

BY DOMINIC MILANO

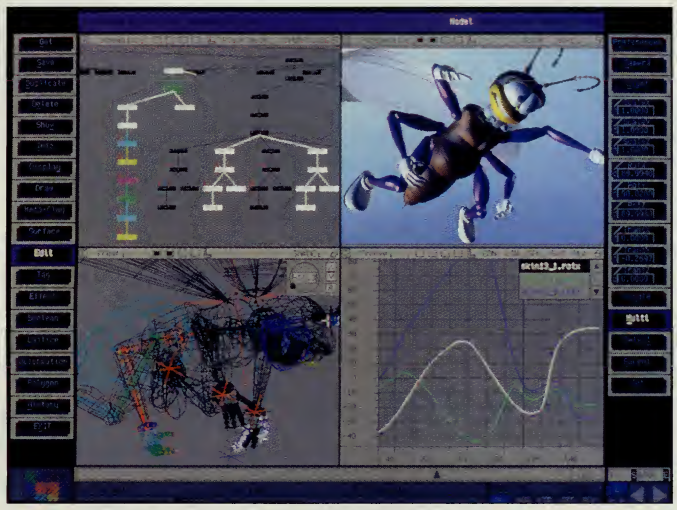
In the land of 3D, few products carry as much mystique as the high-end 3D tools designed for Unix-based workstations from SGI, Sun, HP, and the like. Mention Softimage or Alias/Wavefront to developers who've been using Mac- or PC-based tools and you'll likely be picking their tongues up off the floor.

High-speed Power Macs, Pentiums, the myriad 3D APIs, and associated accelerator cards have brought power once reserved for high-end workstations closer to the desktop. How Alias/Wavefront and Softimage are responding to these challenges makes for interesting reading in and of itself. According to Rob Burges, president of SGI-owned Alias/Wavefront, they're not interested in competing on any platform other than Silicon Graphics workstations.

Microsoft-owned Softimage, on the other hand, is meeting the competition head-on by migrating Softimage from Unix to Windows NT and developing marketing partnerships with various NT workstation vendors. The result: You can pick up Softimage 3D bundled with an NT workstation equipped with 64MB RAM, a couple-gig hard drive, and high-res monitor for as little as $15,000. (For a list of vendors, see page 74.) Stunning, considering that the price of the most basic version of Softimage 3D for Unix/Irix is $7,995. A suitably powered SGI could add another $30,000 or so.

A number of developers profiled in these pages over the past year and a half — Cyan, Trilobyte, and Presto, to name a few — were either transitioning to or had already made the jump from Mac- or PC–based 3D tools to Softimage or Alias/Wavefront running on the Silicon Graphics Indigo 2. So when Softimage offered us the opportunity to run Softimage NT through its paces, we jumped at the chance.

Intergraph loaned us an early TDZ-400 system featuring dual Pentium Pro processors running at 150MHz, 128MB RAM, 4GB hard disk, Intergraph's GLZ1T OpenGL accelerator board, built-in soundcard, SCSI 2 and Ethernet connectors, and a 21" monitor for our tests. We also picked up a DEC Alpha-based 300MHz Carrera NT workstation with 32MB RAM and an AccelGraphics AG-500 OpenGL board, a system that hadn't been certified yet, but that worked nearly without fault. More RAM would have helped immensely, but performance was virtually indistinguishable from that of the Intergraph.



With its menu cells arrayed along the sides of the four-quadrant workspace, Softimage's interface offers quick access to any function. Clockwise from upper left: the schematic view, shaded perspective view, fcurves, and wireframe front view with turntable control enabled to allow easy viewing from any angle. Note transport controls and message line at bottom of the scene.

What was that performance like? Wire frames of objects with tens of thousands of polygons (such as the abominable snowman on the opposite page) could be manipulated in all sorts of ways in glorious real time. As you'd probably expect, in shaded mode with textures and lights applied, such huge objects chugged along at a decidedly slower pace. But the machines were a joy to work on.

After nearly three months of working with multiple betas and finally the release version of Softimage 3.0 NT, I still feel I've hardly scratched its surface. But with Intergraph pleading for their machine back, and Microsoft starting to talk about release 3.5, it was time to file a report.

The Whole Enchilada

Softimage 3D is an all-in-one 3D modeling, animation, and rendering system. It is most highly regarded for its animation — specifically its character animation — capabilities. It's easy to see why once you gain even a modicum of familiarity with it. Animating an object, whether it's a simple flying logo or a complex organic cartoon character running through a maelstrom of madness, is fast and mostly painless. Softimage is easily the most powerful character animation system I've seen.

The NT version is virtually identical to its Irix cousin, though some of its more powerful features, notably the Meta-Clay modeling functions, Mental Ray renderer, and Ray Rebels effects, haven't been ported yet. We're told they're coming in the next release.

During my tests of the release version, I came across a lot of screen refresh glitches (portions of pop-up menus that don't go away after you exit a menu) that are easily dealt with by hitting SHIFT-R, a memory leak or three (sometimes deleting large objects does not clear system memory, so response really slows down even though there's nothing onscreen), and an occasional bug, the worst of which locked the computer up and required a hard reboot.

The bottom line: If you run into something that doesn't make sense, Softimage's customer support people are fabulous. Solutions were never more than a phone call away. It never took more than 15 minutes to get a return call with a solution or explanation as to what I was doing that the system didn't like.

• • • •

Softimage 3D is organized in five modules — Model, Motion, Actor, Matter, and Tools — any of which can be accessed at any time.

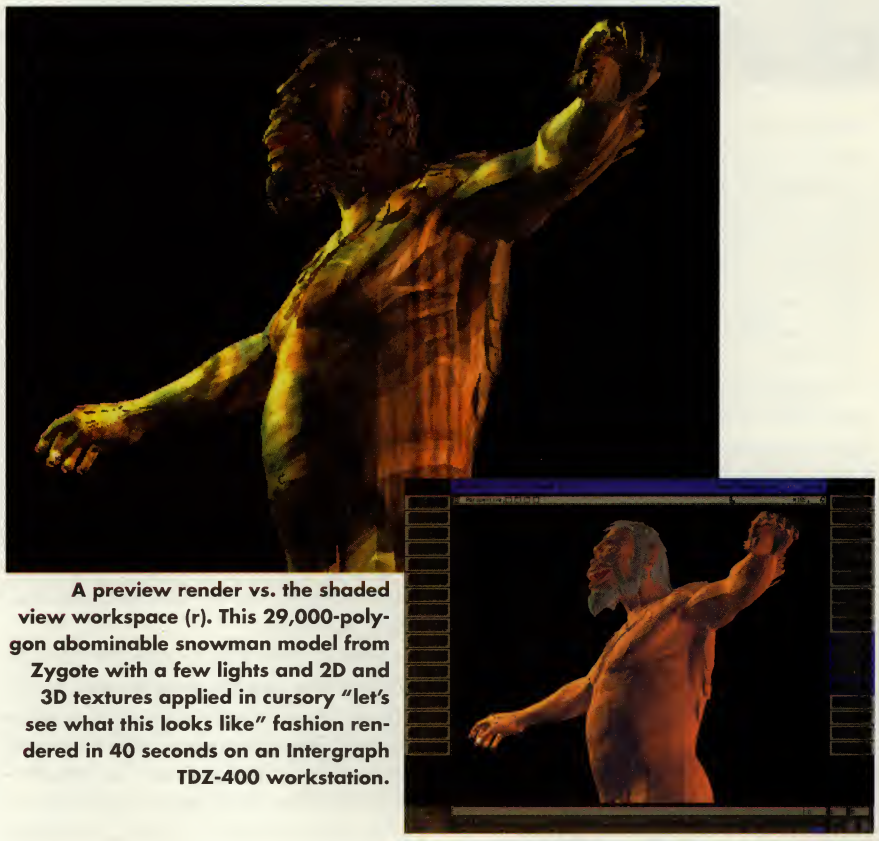
Each module's menu cells are arrayed down the left and right sides of the monitor, leaving the workspace in the center of your screen completely uncluttered. I've heard plenty of complaints from other reviewers about Softimage's non-Windows interface, but from an artist's perspective (I was a painter and a musician long before I became a magazine editor who gets to play with every imaginable 3D modeling program on his Power Mac and Pentium) this aspect of the Softimage interface is brilliant, never mind that it's a little ugly by current Mac or Win95 standards. There's no need for a second monitor to hold tool palettes, no plethora of menus cluttering your screen, and the interaction with menu cells via the three-button mouse is really slick.

Basically, mouse functions are consistent throughout menu cells — left-button clicking a cell selects its submenu, center-button clicking initiates the last function called from the submenu, and right-button clicking exits a menu cell. As operations are initiated from submenus, new mouse button functions are displayed across the bottom of the screen. Combined with simple keyboard shortcuts for selecting menu cells, the mouse button assignments mean that no function is ever more than two or three clicks away. Zoom in/out and object hierarchy selection are also streamlined by simple keyboard shortcuts based on holding down Z or the SPACEBAR while clicking. Brilliant, simple, intuitive, and editable — you can define your own shortcuts using the PREFERENCES menu.

At the bottom of the screen are your basic sequencer forward/reverse/loop/frame controls and timeline display. These are always visible no matter what module you're working in. In the center of your display are four windows (any or all of which can expand to fill the screen) to view different aspects of the workspace — front, right, top, perspective, function curves, schematic, etc.

The interface falls flat on its non-Windows face when you get into its file browsers and the importing and exporting of files, especially non-native files — but more on that later.

The product ships with no less than six very thick, very detailed binders worth of manuals, a Viewpoint DataLabs catalog and CD-ROM of prebuilt models that can be unlocked with passwords on a pay-per-view basis, a short but handy and well-written set of tutorials, the program (on a single CD-ROM), and a copy protection dongle. The latter is the same type as the dongles that come with 3D Studio and Lightscape. If you're planning on running any of those programs on the same machine, the dongles can be chained.



A preview render vs. the shaded view workspace (r). This 29,000-polygon abominable snowman model from Zygote with a few lights and 2D and 3D textures applied in cursory "let's see what this looks like" fashion rendered in 40 seconds on an Intergraph TDZ-400 workstation.

One Bite at a Time

While working in Softimage you'll find yourself bopping back and forth between its five modules, which are selected by a simple mouse click or hit of a function key. Each module governs specific functions — Model is mostly for (duh) modeling stuff, Motion governs animation kinds of things, Actor deals with inverse kinematics (IK) and other physical simulation effects, Matter is where you play with textures and materials and rendering, and Tools is a catch-all for importing and exporting files, generating flipbooks for viewing rendered animations, compositing, and like that.

While virtually everything and anything can be animated in Softimage, the system — particularly the custom effects — is very finicky about how it wants things done, an annoying trait it shares with a number of other modeling systems. For example, tons of functions work only on specific types of objects — polygonal meshes, splines but not NURBS, faces, triangular meshes, models but not metaballs, and so on. The software alerts you when you try to perform an operation on an inappropriate item, but the messages don't necessarily tell you what's wrong and the system offers no mentoring at all.

Say, for example, you want to build some terrain. You grab a primitive of a grid (you're confronted with a dialog that lets you choose between a polygonal grid and a variety of patch and NURBS grids), which you figure you'll use the FRACTALIZE effect on. FRACTALIZE asks you to SELECT A MESH — which means you needed to select a polygonal grid to start with. If you didn't, you go back and do so. So far, so good. When you FRACTALIZE what you think is a mesh grid, you get the error message: REFER TO C:\TEMP\SOFT.STATUS. Huh?

Cracking open the manual or playing through the cool tutorial demo on using the FRACTALIZE effect will not tell you that you need to use the CONVERT function in the EFFECTS menu, which changes the square-polygon mesh to a triangular polygon mesh — but a call to customer support will (thank you, Valerie). After playing around with FRACTALIZE for a while, you'll also realize that to reproduce the beautiful rolling terrain effects so easily achieved in the demo, you have to make your grid's cell size at least 10x10 and the cell count 1x1. The smaller the grid size, the more like the Himalayas or a cavern full of stalactites your fractal landscape will look, even with "small" values entered in the data fields.

Which brings up another important aspect of Softimage: There is almost always more than one way to achieve the effect you're after. Want to make a cube of wiggling Jello? You could start with a primitive cube and meticulously keyframe shape deformations across time. Or

apply a custom effect called ShapeJitter. Or use the Quickstretch effect to subtly twist and bend the cube along a couple of its axes and keyframe the deformations. Or you could use function curves to make the cube slide back and forth in a really tight path to mimic a vibrating tabletop and use Quickstretch to make it automatically flex and bend in the direction it's moving.

That kind of power and flexibility doesn't come without a price, which in Softimage's case is one part steep learning curve and two parts needing to know in advance what you intend to do. It is possible to improvise, but Softimage doesn't always reward spontaneity. At least not if you can't make your way through the program in your sleep.

I often found myself encountering error messages after hours of putting a scene together and deciding it would be cool to animate something or apply a custom effect or whatever only to find the particular object or path wasn't a mesh or a face or a spline or whatever. And while there are all kinds of conversion tools — Face2Mesh, Patch2Mesh, Convert, Spline2Faces — they're scattered throughout the various modules, and they don't always work as expected. (Try Patch2Mesh on a big patch grid and then Fractalize it without tessellating it, the error message is one of my favorites: Can't convert pipe: warning!!! danger ahead!!!)

Similarly, some effects tend to be sensitive to the order they want things done. For example, if you select an effect before you select the spline it needs to see, you're more likely to get a no spline selected message than you are to be asked to select a spline.

Three rules of thumb to remember if you're new to the system: Read the manual. Read the manual. Read the manual. And don't be shy about calling customer support.

The Model Module

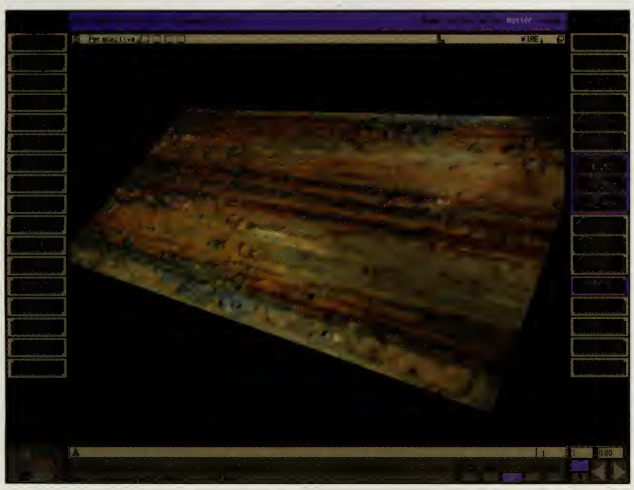
Softimage 3.0 NT is most highly regarded as an animation tool, but it's no slouch in the modeling department. Its conventions are optimized for character animation, so if your goal is to do architectural or CAD modeling, build your objects elsewhere and import them for animation.

A full complement of shape primitives is available including polygon, patch, and NURBS (Non-Uniform Rational B-Spline) 3D objects, a few 2D curves (spirals, arcs, circles, and such), and nulls (very useful objects that have no geometry but that can be used as constraints, hierarchy parents or IK control handles, and so on).

Selecting primitives requires that you make some choices regarding object type and size, accomplished via data fields into which you type numeric values. If you're used to Macintosh-like click-dragging to position and size primitives, don't worry. You won't find it hard to get used to the numeric system. And it's easy to rescale any object in any or all directions by click-dragging it with the Scale xyz menu selected.

If you're a Strata Studio Pro Blitz user, you may wonder where the rounded-edge primitives are. There aren't any — Softimage offers something better: A Rounding effect lets you round the edges of any object by an adjustable amount.

In addition to modeling with primitives, you can draw faces and polygons, draw and extrude curves of all sorts (Linear, Bezier, B-Spline, and Cardinal — it does linear and cubic NURBS too, but extruded NURBS aren't supported yet), extrude polygons on curves (very slick), extrude and/or bevel text, put a skin over two or more curves, and perform relational modeling operations. The latter allows you to do things like draw a spline, extrude it (which creates a new object), and keyframe shape deformations of the original spline that will deform the extruded object as well as the original (called a *generator* in Softimage speak). Which is a very cool and easy way to animate complex events.



Softimage allows you to view 2D textures on surfaces. Shown here, a simple PIC file mapped to a patch grid with two spotlights pointing at it. Any of the elements can be tweaked while the results are displayed in real time.

Generators can be virtually any curve, patch object, or face — only a couple of surfacing operations won't work on relational NURBS generators yet. Incredibly powerful stuff that saves not only time but hard disk space.

Another relational modeling-like function is the ability to make *instances* of objects or object hierarchies. Unlike a duplicate, which makes an independent copy of the original, an instance generates one master object or hierarchy and creates a pointer to it, producing a virtual replication of the master. Modify the master and the instances will also be affected. Swap the master model for another and all the instances will change too.

There are all kinds of tools for manipulating polygons in useful ways. You can perform translations and deformations on single points or entire groups of points. You can perform rotations, scaling, and translations on those points relative to all sorts of coordinates (local, global, references, and so on), and since you can save any and all of those operations as keyframed events, they can all be animated.

Lattices offer another way to deform objects or groups of objects quickly and easily. Basically, a lattice is a cubed grid whose points form a relationship with points on an object. Tagging and manipulating points on the lattice alters the shape of the model. Some Lattice foibles: You have three MakeLattice effects to choose from, one of which requires you to refresh the screen manually to see the effect, and if you're a Softimage virgin, figuring out which one to use in a given situation based on what little detail there is in the manual will drive you crazy. If you're stumped, a call to customer support will quickly sort things out. Hint: If you want to apply a lattice to a large object hierarchy, select the entire hierarchy by clicking its parent and use Lattice—Branch—Create in the Model module to apply the lattice to the hierarchy in one click. Like most every other effect in Softimage, lattices can be animated — the effect became famous when it was used to deform actors' heads in *Beetlejuice* and *Death Becomes Her*.

How do you make holes in objects? Depends on what kind of object you're dealing with, naturally. If you're working with a face, you have to draw the hole. If your object is polygonal, you can use Booleans to cut holes, merge geometry, and otherwise do all the kinds of things you'd normally do with Booleans. If your object is a NURBS surface, you'd use the Trim Nurbs Surface function, which has a full 10 manual pages devoted to its operation, so I'm not even going to try to explain how it works here. Suffice to say you can do a lot with it — make nested holes, project multiple shapes onto a NURBS object that

make holes cookie-cutter style, and so on — all of which can be animated.

I mentioned earlier that a number of conversion utilities are included in the system. I didn't mention that most of them are custom effects included to augment the general CONVERT effect that allows you to change faces, curves, and surfaces into different kinds of objects. For example, you can use CONVERT to transform one kind of curve into any other including NURBS, change a face to a polygon mesh, turn a patch surface into polygons or a NURBS surface, and so on. If you perform a CONVERT on an object hierarchy, don't think the system is on the fritz when the dialog box keeps coming back at you after you click OKAY. The effect steps through each object in the hierarchy, asking you to say OKAY at every step, though it does not give you any indication what object it's affecting at the moment.

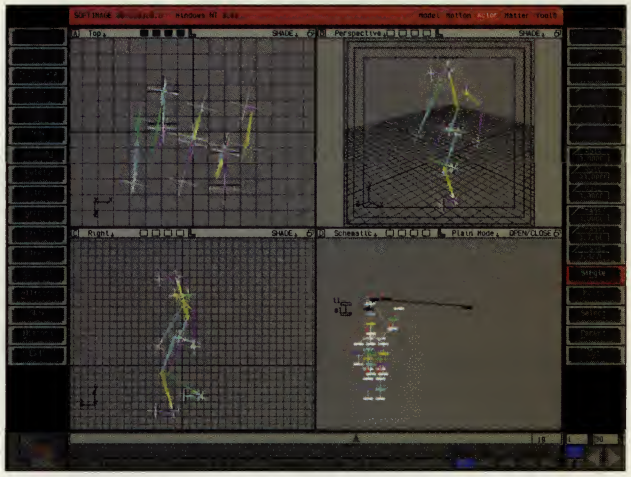
The seeming redundancy of the various custom conversion tools stems from the fact that they were originally plug-ins offered by a company called Minerva that eventually became part of Softimage. The custom effect conversion utilities will work on an entire hierarchy in a single pass.

Speaking of custom effects, plenty of them are scattered throughout the five modules. A few of the effects included in the Model module's menus:

PUSH increases the size of an object by a specified amount. There's also an animated version in the Motion module that can make objects look like they're breathing, growing, whatever.

RANDOMIZE can be applied to an object to make it look less than perfect. It can also be used to create pseudo-fractalized terrain that doesn't eat up nearly the polygon counts the FRACTALIZE effect generates. Extreme settings can make a sphere look like a Brancuzzi sculpture.

SLICE and MULTISLICE allow you to perform a Boolean-like slicing effect on a hierarchy.



Softimage's inverse kinematics is one of its most powerful features. This humanoid IK chain and a keyframed animation of it walking took minutes to put together.

BUMPMAP is a really cool effect that can turn geometric primitives into incredible organic shapes. But of course you can also use it to emboss a picture file, which must be in Softimage's PIC native format onto a surface via its RGB and/or alpha channels.

BREAKUP modifies meshes so that no vertex is referenced by more than one polygon, useful for breaking down mesh objects or creating explosion effects.

MERGEGEOMETRY lets you draw shapes with splines and merge them with meshes without having to manipulate points; the demo for it is too cool for words.

That's just a few of them. As cool as all that is, we sorely miss Softimage's metaball (Meta-Clay in Softimage speak) functions, which allow you to build organic objects using relatively little geometry. We're told Meta-Clay is coming out for NT shortly. However, a slew of programs for the Mac and PC that cost hundreds, not thousands, of dollars, include metaball functions, so it's no surprise that a lot of power users build their geometry in other high- and low-end programs and import them into Softimage when it's time to

IMPORTING NON-NATIVE FILES

Since so many developers mix and match modeling systems, choosing various packages for their particular strengths at generating hard-edged geometry, particle effects, and so on, I thought I'd try importing bunches of custom models and texture maps saved in a variety of formats.

What I found was not pretty.

The first bump I hit was a boneheaded user error related to how Windows NT handles permissions. Turns out NT's network administration functions allow you to grant or limit access to databases — handy if you want to make sure you maintain version control over a ton of digital assets. If your permissions are set up wrong, you might find yourself locked out of databases you need to get to. The fix is simple enough — log on as the network administrator and grant yourself permission to see everything.

The real hassles are in the ways Softimage retrieves and displays files in its databases. Each retrieval function, from GET and OLD FASHIONED GET TO IMPORT, calls up browsers whose conventions were ported directly from Unix. They're ugly, not very conventional, and desperately in need of a redesign to bring them up to 1996 file handling standards.

If you're importing non-native format files, rather than simply double-clicking on them and having Softimage automatically do a file conversion, you have to use one of several conversion utilities that don't all operate the same way and aren't all located in the same module. Some allow you to double-click files displayed in their browser, others won't show you which files are available in their browser but will allow you to load them by typing their path and file name. Still others require that you open a DOS shell, convert the file, and set various parameters by typing in pathnames and command line stuff. Sometimes you're required to answer dialogs that assume you have intimate knowledge of the files you're trying to import, others are case-sensitive, and still others don't want you to enter the file extension at all. Argh.

So do the conversion utilities work? Yes.

I ran tests on a beautiful abominable snowman supplied by Dan Farr at Zygote, who delivered it via ftp. It started as both a .3ds and .obj file. Using 3DS2SOFT, the model imported and displayed on screen without a hitch. Even the individual elements retained their names when displayed in the schematic window. Softimage wouldn't recognize the OBJ version.

Using Strata Studio Pro Blitz' SAVE AS I grabbed and converted some Acuris vehicle models, which imported okay, though they needed to be resized because they came in so small. Unlike the Zygote model, the Acuris stuff lost its individual part names.

One of the only fatal bugs I encountered with the system was related to using OLD FASHIONED GET. If you happen to open the Perspective window to full-screen size while trying to import something, the screen will sometimes lock open and the only way to switch back to the quad view is to exit the program and relaunch.

animate them.

I tested importing a variety of file formats using the browsers and myriad utilities included with Softimage and experienced varying degrees of success.. If there's any one area where Softimage could improve, this is it (see "Importing Non-Native Files," page 71, for details).

Matter and Tools

Adding texture and color to an object either globally or on local surfaces takes place in the Matter module. Any texturing parameter can be keyframed and thus animated. Before you can apply a 2D or 3D texture to a surface, you have to attach a material to it. The Materials Editor offers a number of shading models — Blinn, Phong, Lambert, Constant, and Shadow Object. Each processes light in relation to surface normals differently and the Texture Editor allows you to view a texture map on the defined material so you can see what the interaction of the two will look like.

Material parameters include things such as specular, ambient, and diffuse lighting colors (which you can adjust in a bunch of ways), transparency, reflectivity, refraction, and static blur (which makes the edges of objects fuzzy). Materials can be saved to libraries and you can use the editor to define more than one material at a time.

As for texture maps, they can be used to map color, surface roughness, reflectivity, and transparency. The alpha channel and RGB intensity of the image being used as a texture can also be used as a mask. Pictures used as local or global 2D textures have to be in native Softimage PIC format. If you're a normal red-blooded developer, you're probably scanning pictures or using Adobe Photoshop to generate textures. Bringing those files into Softimage requires you to run one of the file format conversion utilities in the DOS shell of the Tools module (see the sidebar on importing non-native files for details).

Once the system can see the texture file, you can map it to all or part of an object on its xy, xz, or yz axes, or map to uv coordinates to get less distortion from stretching (this only works on patch surfaces). Picture files can be scaled, offset, or tiled in various ways. A really bare-bones paint utility is included for touching up images and painting bump maps. How bare-bones? It's so primitive that I'd only use it for the most simple touchups or when I was feeling too lazy to go through the file conversion hassle required to rework a picture in Photoshop or Fractal Painter.

Procedural 3D textures come in three basic flavors, marble, wood, and cloud, which basically determine the overall grain or fuzziness of the texture. You can tweak spacing, deformations, orientation of the grain, the number of iterations, reflectivity, transparency, roughness, scaling, and rotation; view the texture spherically or on a plane; and save it to a library. Oh, and keyframe everything. In short, 3D solid textures can produce all kinds of subtle faux textures.

Of course, all this interacts with your light sources, which like everything else can be animated in every way imaginable and saved to a library. Lights can be set up as spots, infinite sources, points, and the sun. (Yep, there's even a library of location-based sunlight — sunlight as it would appear at cities around the world at various times of the year; if the location you're looking for isn't in the database, you can enter longitude, latitude, time, day, and year to get just the right setting.)

Shadows, soft shadows, depth mapping, and atmospheric effects such as fog are supported. Umbra and penumbra intensity can be adjusted. I've heard lots of power users complain about Softimage's renderer. Personally, I thought it looked pretty darn good, but I still miss the Mental Ray shaders that are coming to the NT version soon.

What do things show up like on your monitor? While you're working, you can view objects in a hardware-shaded mode. Most of the time you'll probably want to view things as simply as possible to get an overall feel for

A POWER USER'S POINT OF VIEW

Looking for a second opinion from within the professional community, we discovered through the grapevine that Amblin Entertainment's animators have been beta testing Softimage NT for months. Amblin's Grant Boucher shares his thoughts on Softimage 3.0 NT:

We've been evaluating Softimage NT but we haven't delivered any projects with it yet. What's exciting to us is this whole market shift, where products are being made available on multiple platforms, including fast, inexpensive, powerful NT machines.

We've been using NewTek Lightwave, which is available on both SGI and NT platforms. Softimage NT brings character animation to the table. And the Mental Ray renderer works across Alias and Softimage. The time is coming when people will be able to work across all of these environments. In my business, that will allow us to do more and charge less.

What we like about Softimage NT is the way it feels like the SGI version only faster and better. We've done rendering tests, but most people render with an outside renderer so most of our stuff has been focused on character animation R&D.

Our goal is to be able to deliver whatever is asked of us, so our guys were most interested in Softimage's IK system. What we would like to see improved is the same thing that everyone is doing a lot of R&D on these days: muscle and human bone type animation systems. We're very satisfied with the Softimage IK system. My concern was the ancillary products that aren't ported over yet, but it's supposed to be imminent so my main concern seems to be getting addressed.

The other concern is Softimage's internal render engine, but most people are using external renderers — Renderman or Mental Ray — so for my money that's not an issue. It's an issue for Autodesk 3D Studio Max, which doesn't have rendering for squat. It's not an issue for Lightwave, which has excellent renderers built in and is now extensible.

We want to integrate the two to take Softimage's character animation system and pass it to Lightwave's render engine. But if Mental Ray comes through the way I'm hearing, I don't think that's going to be an issue.

The other problem is the way Softimage handles importing files. Our programmers are working on our own programs to make that seamless. Which is why it's good that Softimage has an open architecture. We've got some advanced polygonal modelers with Lightwave, and of course everyone is taking data from Alias/Wavefront; people doing game stuff are using 3D Studio. That data conversion should be seamless. You should be able to load an image and save it to whatever file format you want. In Lightwave, you load it, it says "This is a 3DS file," and that's it.

But it was a straight port. It wasn't an evolution. It must have been a huge project — it took Lightwave a year and a half to get new features, have the extensibility, and be available on multiple platforms. If there's one disadvantage to Softimage it's that it *looks* too much like the SGI version.

lighting and color. But a Shade View Setup option lets you view texture maps on the objects they're attached to without having to do a rendered preview. You can even manipulate textured objects in real time to see how lights will affect them at different angles (thank God for OpenGL, GLiNT chips, and hardware accelerator cards). Previewing in this way isn't completely accurate because the preview light tends to be darker than the final rendered light.

Finally, there are all kinds of functions in the Tools module for importing and exporting files, outputting to film in every imaginable aspect ratio and format, outputting to Alias, Vertigo, Wavefront, Targa, and other formats, compositing, accessing your own plug-ins, and so on.

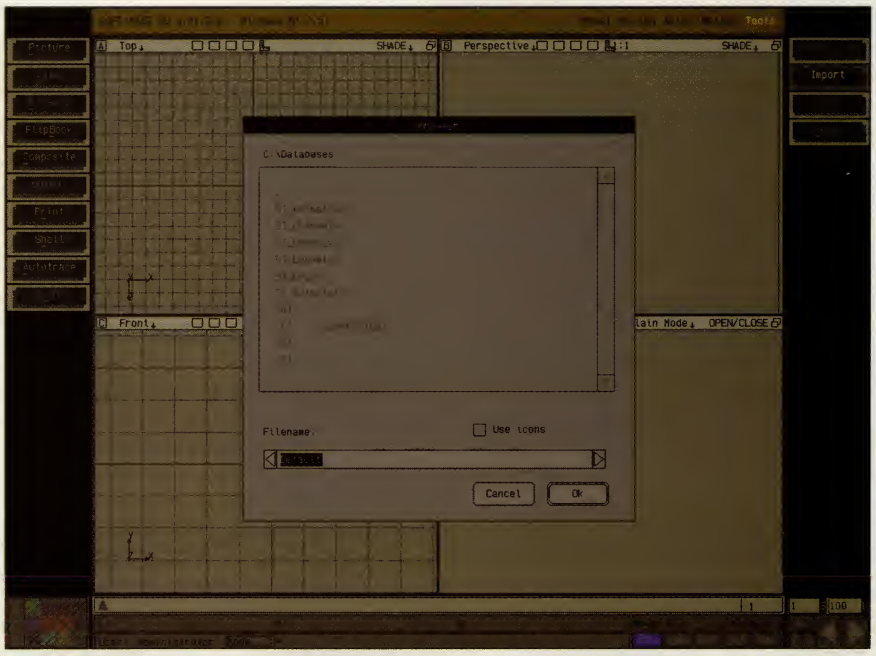
The Motion and Actor Modules

Softimage rules when it comes to animation. Its fast, deep, and extensible functions allow you to make virtually anything and everything — models, 2D and 3D textures, lights, cameras, materials, custom effects, IK, dynamic physical properties, deformations, atmospheric effects, and almost every parameter related to those things, as well as a lot more — move or transform over time. Techniques supported are traditional keyframing, procedural animation, and realtime input/output animation.

You can keyframe by setting the sequencer to the desired frame, setting up your scene or object or event the way you want it, and recording the frame, repeating as necessary to get the desired animation. You can adjust how the system interpolates events between keyframes by editing function curves, which we'll get to in a second. You can also set the system to advance itself automatically by whatever number of frames you'd like. Another way to keyframe is within various dialog boxes related to stuff like materials, camera settings, certain custom effects, etc. But any way you do it, the process is fast and easy.

The options for what you can capture as a keyframe event are myriad — object scaling, rotation, shape, lattice, node lattice, node spline deformation, branch lattice, keypad translation, and so on; camera roll, field of view, auto focus, custom focus, interest, and more; light cone angle, spread angle, umbra, area geometry rotation or scaling, and others; wave rotation, scaling, translation; shape and cluster animation (used for various interpolation effects such as adding a surprised expression to a scared expression to get open-mouthed terror) — you get the idea.

Nearly every animation operation produces a function curve (fcurve for short). Fcurves show up as lines on a graph representing motion over time. You can edit fcurves, add points to them, copy them, save them to libraries, break down



Softimage's file browser is the single aspect of the system in need of a complete overhaul. Trying to find a file can seem like you're looking for single grain of sand on a beach, though some of the browsers, such as the one seen here, allow you to type in exact path and file names. Handy, considering non-native files don't always show up in the browser windows.

complex animations by watching the effect of one function curve at a time, and so on.

You can display any imaginable single fcurve. But you'll want to get really familiar with fcurve shorthand, that is, the labels Softimage puts on curves in the fcurve display, because at some point you're going to want to view all fcurves simultaneously. (Especially after performing certain procedural effects where you may not have any idea what kind of curves the effect generated.) Most of the shorthand is really simple, but some may as well be hieroglyphic Urdu. I mean, "rvcrtl1.rvely"? Okay, it stands for "rotational velocity control 1, rotational velocity on the y axis." Learn the shorthand and you'll also have some clue as to how to work with Expressions, a feature that generates animation based on mathematical formulas, that is, writing code. The manual includes a bunch of tutorials that even the trigonometrically challenged like me can understand, though I'm not even going to try to evaluate that aspect of Softimage.

If the thought of animating by code scares you, don't worry. There's plenty for an artist to love in the other procedural animation features. Procedural functions more or less automate things that would otherwise take days of tweaking keyframes.

Many, many custom effects (including those mentioned earlier) allow you to manipulate lots of parameters and otherwise simulate complex motions and physical properties. Things get really interesting when you combine procedural effects with path animation and spline/patch deformation functions.

What's path animation? It lets you assign all kinds of things to travel on curves drawn in the Model module — think models, the camera, the camera's interest (where it points), lights, nulls that act as constraints to keep a group of objects oriented in a particular direction (like, say, a crowd sitting perfectly still at a tennis match but their eyes follow the ball in unison), ad infinitum, cruising along a spline at the click of a button. Spline and object deformation let you alter the shape of things based on curves or even other objects that take the place of those object's axes — think logos that glide along the curve of a mountainside, a fish's body that flows along the curve of its path, Dali-esque melted clocks that flow across a rolling landscape, and so on.

Curves can be converted into waveforms that can ripple through stuff in a number of ways. (I was surprised that Softimage doesn't come with a library of simple waveforms, such as sines, sawtooth, or pulse waves. Instead you have to draw them yourself.) A Flock Animation algorithm (you build three mesh objects then fill in a veritable boatload of parameters in the dialog box that pops up) allows simulations of swarms of bees, fireworks, snowstorms, and such. And a host of other custom effects simulate all sorts of cool realistic events

from cloth falling onto objects to things that materialize out of nowhere to carpet being unrolled onto a surface.

The custom effects are extremely cool, but the tutorials don't explain the finer points of their operation very well — critical details about how a particular demo was set up often are left out, which can send you searching for needles in haystacks when you try to duplicate an effect on your own.

Softimage supports a plethora of realtime input/output devices ranging from motion capture systems of all sorts (BioVision, Acclaim, Ascension, Polhemus) to the well known monkey posture-capture device to realtime control via your computer's mouse to audio input (speak into a mike and make something move with the sound of your voice) to MIDI drivers. BioVision was kind enough to supply us with some test files on 4mm DAT, but none of the DAT drives connected to our corporate network were compatible with NT, so we had to resort to scamming, er, borrowing a SCSI 2 DAT drive from Sony. It showed up the day we went to press, so stay tuned.

We were similarly unlucky when it came to testing Softimage's capacity to capture realtime input from a MIDI controller. Our pre-release TDZ-400 did not have a soundcard with a standard joystick port to which we would have attached a joystick-to-MIDI in, out, and thru connector. The machine, however, did have a MIDI driver for NT, which was a good thing, as none of the MIDI interface manufacturers seemed to have any idea where to get an NT driver, though Roland thought there might be a public domain driver somewhere on CompuServe — if it's there, we couldn't find it. If you're planning to do MIDI on one of the Alpha workstations, better make sure you can connect a MIDI interface to it. We polled nearly all of the MIDI interface manufacturers and none had NT drivers for their boxes.

While I wasn't able to test drive MIDI as a realtime animation controller, here's a tip: Softimage is set up to respond to MIDI note numbers and velocity data. Clearly, whoever wrote their MIDI driver was expecting people to want to use an electronic keyboard or MIDI sequencer to drive animation, which is possible but not the best use of the technology. (Who's to say whether MIDI notes would be interesting both musically and as control data.)

It would make infinitely more sense to connect one of the many MIDI fader boxes on the market such as those made by JL Cooper and Peavey and use them as off-the-shelf waldos. They're really inexpensive ($299 to $800 for a top-of-the line unit), programmable, offer 16 or more physical sliders that can be assigned to any MIDI controller number that can be attached to any Softimage animatable function. This enables you to push sliders and do stuff like move IK chains around and shape deform NURBS to get blinking eyes, talking mouths, and such in real time.

Softimage supports up to 1,000 simultaneous channels of realtime input. Captured data can be routed in a number of useful ways, one of which is straight to function curves. Of course, this allows you to tweak motion data in any way you'd edit an fcurve.

Inverse kinematics is probably the single most sought-after feature in lower-end animation programs, a number of which have either just added it or are planning to add it this year. IK makes building moving models a breeze. Softimage's IK lets you build articulated chains using 2D and 3D joints. (The difference is in range of motion. A 2D joint will only move in one plane like an elbow. A 3D joint will rotate in any direction like a wrist.) At the end of each joint in the chain is an effector. Grabbing the effector anywhere along the chain (via mouse or a realtime input device assigned to its channel) allows you to move the entire chain around as if it were a skeleton. So moving a hand effector will pull the forearm and biceps along with it in a very lifelike way.

PRICE WAR!

The initial spate of hot deals on NT-based workstations that basically throw in Softimage NT for free were scheduled to run out Feb. 29, but have been extended through the end of April. Each of the certified vendors listed here offers systems with incredible bang for the buck.

But new prices, configurations, and models are being announced even as this is being typed. Rather than print a bunch of information that'll be out of date by the time it reaches you, we've simply included a list of companies currently working with Microsoft to offer Softimage bundles. (The list itself is expanding, so you may want to get an update from Microsoft.) If you're inclined to jump on the NT rocketship, you'll do well to be on your toes. Pick up the phone or type in the URL to get the latest on some of the best values ever in 3D graphics.

• **Aspen**, 4026 Youngfield St., Wheat Ridge, CO 80033-3862; vox 303.431.4606; fax 303.431.7196; email aspen@aspsys.com.
Reader Service #170

• **Carrera**, 23181 Verdugo Dr., Bldg. 100, Laguna Hills, CA 92653; vox 800.576.7472, 714.707.5051; fax 714.707.5053; Web http//www.carrera.com/.
Reader Service #171

• **DayStar**, 5556 Atlanta Hwy., Flowery Branch, GA 30542; vox 770.967.2077; fax 770.967.3018; Web http://www.daystar.com/.
Reader Service #172

• **DeskStation**, 13256 W. 98th St., Lenexa, KS 66215; vox 800.793.3375, 913.599.1900; fax 913.599.4024; email sales@dti.com; Web http://www.dti.com.
Reader Service #173

• **Digital**, One Digital Dr., Merrimack, NH 03054; vox 800.344.4825, 603.884.5111; fax 800.676.7517; Web http://www.digital.com.
Reader Service #174

• **Intergraph**, CR1102, Huntsville, AL 35894-0001; vox 800.763.0242, 205.730.2000; fax 205.730.6188; Web http://www.intergraph.com/ics.
Reader Service #175

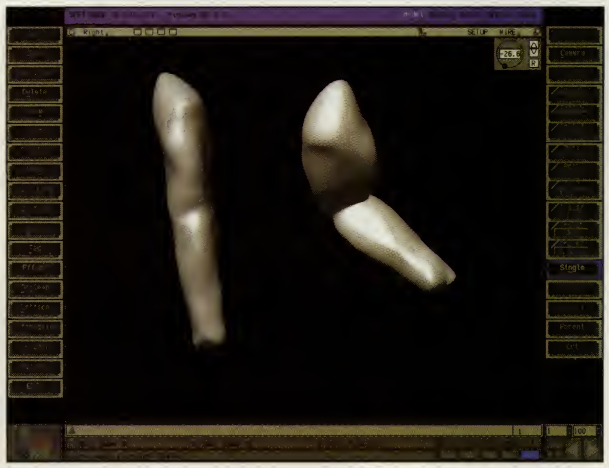
• **NEC**, 339 N. Bernardo Ave., Mountain View, CA 94043; vox 415.528.6000; fax 415.528.5850; Web http://www.nec.com.
Reader Service #176

• **NeTpower**, 545 Oakmead Pkwy., Sunnyvale, CA 94086; vox 800.801.0900, 408.522.5199; fax 408.522.2666; email info@netpower.com; Web http://www.netpower.com.
Reader Service #177

• **Silicon Graphics**, 2011 N. Shoreline Blvd., Mountain View, CA 94043-1389; vox 415.960.1980; fax 415.961.0595; Web http://www.sgi.com.
Reader Service #178

Each joint in a kinematic chain can be constrained to simulate natural limits of motion and you can apply a variety of envelopes over articulated chains, which is important given that an IK skeleton is not visible to the renderer. If you want to give it substance, you'll have to use the Automatic Envelope function or assign a model as an envelope.

Envelopes that pertain to more than one joint can be weighted and you can set deformations according to curves, which helps simulate bulging biceps and such. When you use the Auto Envelope function, a new chain is created with a flexible skin on it that you can edit. I found I could tweak the balloon-like envelope of a forearm/biceps to look fairly realistic in minutes. Combine that look with the automatic deformation feature, in which you can set the amount of bulge you'll get when a biceps flexes, and you get very realistic anatomy very quickly.



What's Softimage's learning curve like? The system is incredibly deep, so don't expect to learn it overnight, but on my very first pass at an IK chain, it took minutes to tweak a simple balloony auto-envelope to resemble a crude arm and apply an effect that makes the biceps muscle bulge when flexed.

IK tips: Effectors and nulls look identical. Using the schematic window and color coding effectors and nulls will make sorting out the visual soup a lot easier.

Objects can be assigned a density, static and kinetic roughness, and elasticity, so that when other physical simulation effects are applied to your virtual world, those objects behave accordingly. These dynamics can also be keyframed and thus animated. The result: Gravity will make things fall, collision detection will make things bounce and roll according to their elasticity and roughness settings, fan and wind effects will push stuff away or blow ripples through them, and so on.

PROS AND CONS

Pros

Unparalleled character animation system, brilliant tools interface, runs on fast and relatively inexpensive NT workstations.

Cons

File handling interface needs an overhaul, finicky about how it wants things done.

Bottom Line

Softimage is the most powerful and easy to use character animation system on the market.

The Bottom Line

Softimage 3.0 NT has its foibles, but as a character animation system, it's awesome. When the Mental Ray shaders, Ray Rebels effects, and Meta-Clay modeler get ported it'll get even better.

If you're familiar with modeling and animation, it won't take long before you're describing Softimage, foibles and all, as intuitive. If you're a Softimage Irix user, you'll be up and running in no time. Literally. Installation takes about 15 minutes, a vast improvement over the hours you have to spend installing the Irix version. You'll also notice that NT workstation performance is actually slightly faster than last year's Indigo 2s (stay tuned for comparative performance tests).

The introductory system bundles, which have been extended beyond the onsale date of this issue, are absolute steals. Add to that their ease of use, high-end performance, and the number of programs being ported to NT, and you've got a very attractive addition to any interactive media production studio.

Softimage 3D 3.0 is currently the most powerful character animation system available for NT. Even at its unbundled price of $7,995, it's reason enough to dive into NT.

Special thanks to Tim Horne, Andrew Mackles, and Valerie Demers at Softimage, Zygote's Dan Farr, the folks at Acuris and BioVision, Greg Milliken of AccelGraphics, Intergraph's Clive Maxfield and Greg Kesselhorf, TSI's Tom Richardson, and Amblin's Grant Boucher for their assistance in putting together this review.

SOFTIMAGE 3D NT

Description

High-end open architecture 3D modeling and animation system.

System Requirements

Windows NT: Pentium Pro, Digital Alpha, or MIPS 4400 processor-based workstation, NT 3.51 w/Service Pack 2 or better. **SGI:** Workstation, Irix 5.2 or better. **Both:** 64MB RAM, 1GB hard drive, 200MB swap file, CD-ROM drive.

Features

Polygon, spline, and NURBS-based 2D/3D primitives; animation-based modeling functions, Booleans, polygonal operations, relational modeling, polygon reduction, dynamic motion effects, path animation, spline deformation, function curve editing, constraints, Q-Stretch, animation effects (flock, wave, jitter, limit, magnet, polyshrink), realtime motion capture input, inverse and direct kinematics, dynamic effects (gravity, force, friction, mass, wind, nail, collision), skinning, weighted and rigid enveloping, various shading types supported, 2D and 3D texture mapping, 3D solid textures, ambience, fog, depth fading, camera memory, keyframe and procedural animation, palette reduction, etc.

File Support

Import/Export Image Formats: Artisan, Alias, Everest, RGB, RGBA, SGI, Targa, TIFF, PIC, Vertigo, Wavefront, YUV, AVI, DIB. **Import/Export Object Formats:** DXF, IGES, 3DS. **Import Image Formats:** JPEG, GIF, IFL, BMP, FLC, FLI, CEL.

Suggested Retail Price

$7,995.

Contact

Microsoft, One Microsoft Way, Redmond, WA 98052; vox 800.576.3846, 206.365.1359; fax 206.936.7329; Web http://www.softimage.com or http://www.microsoft. com.

Reader Service #178

NECESSITY MAKES STRANGE HYPERTEXT

ADOBE PAGEMILL 1.0 FOR MAC

BY MICHAEL MACRONE

From a recent posting to the "PageMill-Talk" Internet mailing list: "I am a novice to the world of HTML editing, but it looks like I may be given the job of Webmaster at the company where I work, so I have a lot to learn."

Indeed. It's a fair distance from novice to Webmaster, farther than the writer (or his employer) knows. But in the mad rush of seemingly everyone to get on the Web, experience has become a luxury. Necessity will acquaint many a worker with strange hypertext.

Just as Adobe PageMaker and Quark XPress have turned administrative staff into instant graphic designers, sparing their companies the expense of professional help, Adobe PageMill promises to make Web publishing fast, easy, and accessible. No longer must one endure the rigors of hypertext markup language (HTML). No more is Web publishing the province of geeks.

PageMill's packaging and literature emphasize the program's ease of use, in contrast to the complexity and tedium of writing HTML with, as the manual puts it, "stone-age" tools such as word processors. But this oversells HTML's actual difficulty and thus the virtues of the product. As it happens, the basics of HTML are rather simple—it's a *markup language,* not a programming language. Once you've grasped the idea of enclosing elements in descriptive containers, you've grasped the essential technique.

For example:

```
<TITLE> Sample HTML Markup </TITLE>
```

defines "Sample HTML Markup" as the title of a hypertext document. Most HTML tags come in pairs like this, the closing tag merely repeating the first with the addition of a slash. It's practically human-readable.

Some HTML elements are harder to master than others, of course, but PageMill can't handle most of them (such as text-block alignment, tables, and frames). And the really difficult stuff — namely scripting and other server-side operations — is far beyond the program's scope. Mostly, PageMill automates the most basic and common coding, which saves the user from frustrating typos but which doesn't save a great deal of brain power.

So why PageMill? Because while typing tags such as <BODY></BODY> is simple, it requires a certain mastery of how HTML syntax translates into what you see in a browser window. The problem is twofold. On one hand, there's the code barrier, or the difficulty most people have with symbolic mapping. On the other, there's the gap between hard code and visual result.

In a nutshell, what PageMill offers — as yet a unique feature in the rapidly expanding universe of HTML tools — is WYSIWYG. Many other HTML editors offer at least a GUI, with menus, toolbars, palettes, and other shields from raw code, and like PageMill, they automate tasks that are surely tedious. As for previewing, none of them prohibits you from constructing Web pages in one window and switching to a browser such as Mosaic or Netscape to check the results. But no other HTML editor offers a graphical authoring environment in which you build pages visually rather than building them with code.

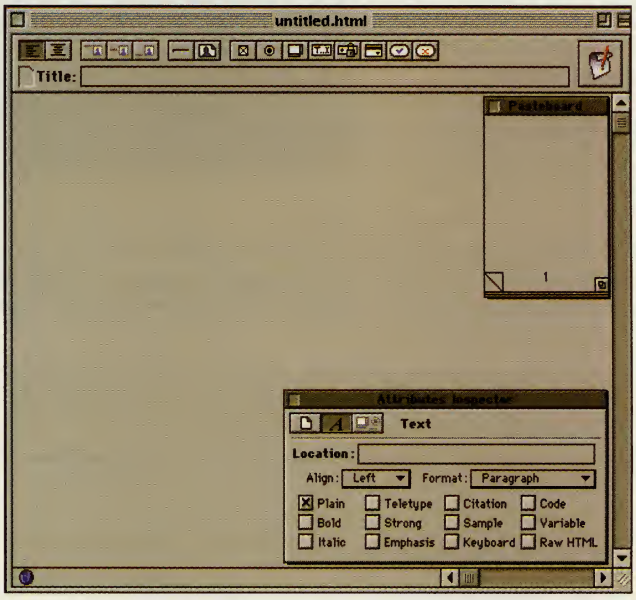


Figure 1. PageMill's interface. The document window is a construction area that simulates a generic Web browser and allows you to test local links in preview mode. The Pasteboard is a way station for images and text. The Attributes Inspector presents formatting and link information for the page as a whole or for whichever object is selected in the document window.

Grinding the Mill

The major elements of PageMill's interface (Fig. 1) are the document window, its toolbar, the Pasteboard palette, and Attributes Inspector. The document window is PageMill's construction area, simulating a generic Web browser and allowing you to test local links in preview mode. The Pasteboard is a way station for images and text, akin to Apple's Scrapbook. The Attributes Inspector (clearly inspired by Freehand's Inspector) presents formatting and link information for the page as a whole or for whichever object is selected in the document window.

Although it's possible to get a sense of PageMill's functionality by plugging and playing, you won't get very far without reading the manual — particularly as online help is limited to minimal labels for the toolbar icons. Suppose you decide after typing a few lines in the editor that you'd like to place an image to the right of your text. After passing the mouse over the toolbar and finding an Insert Image button, you click it. The result is a dialog box that, contrary to Apple's Human Interface Guidelines, doesn't tell you what it's asking for (Fig. 2). Clever users will surmise that PageMill is looking for an image to insert, but there's no indication that only certain formats are supported. And if you expected the text to wrap as it would in a page layout program, you'll be surprised by the result (Fig. 3).

Frustratingly, the user manual never touches on the major limitations of placing and aligning images in PageMill, or on why placing an image as I just did splits apart lines of text. (Mystery solved: PageMill doesn't support several newer HTML tags that enable an image to be aligned to the

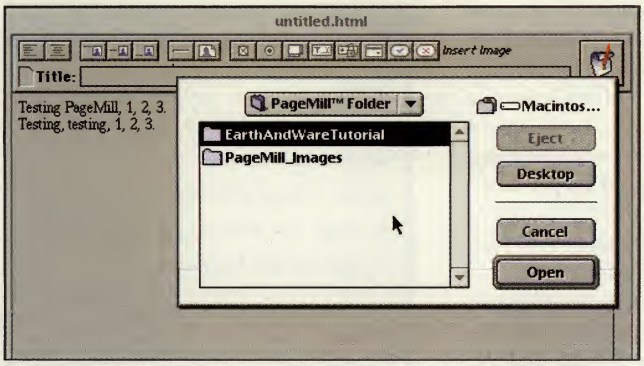


Figure 2. If you select INSERT IMAGE from the toolbar, a dialog box appears that doesn't tell you what it's asking for.

right or left of a text block, such as <IMG ALIGN = left>.) Constructed as a tutorial rather than a reference, the manual doesn't even mention situations the program isn't designed to handle. The examples presented (in which graphics are placed either on lines by themselves or on lines with non-breaking text) are far less troublesome.

Placing images is child's play compared to, say, creating imagemaps (graphical files with embedded Internet hyperlinks), which to its credit PageMill does rather well. But getting the imagemaps you create to actually work is a different matter. It helps a lot to know something about them before you start — for example, that they require server-side Common Gateway Interface (CGI) scripts and that the ASCII map file associated with the graphic must be placed in a specific directory. The manual's help with these issues is typical of its help with the more technical (but unavoidable) details of actually getting your pages to work: "To tell the server where to find the imagemap, check with your Webmaster (server administrator)."

One shouldn't expect too much from PageMill's manual (though one might have expected an index). On its own terms — as a guide to getting pages ready for the Web, if not getting them online — it's a nice piece of writing, clear and well organized. And PageMill's feature set is small enough to master quickly, though this turns out to be a mixed blessing.

Capabilities

PageMill is a capable tool for creating simple Web pages, offering the interface and shortcuts of a basic word processor. You can enter text manually or cut and paste it from another application (bold and italic styles are preserved, but other text formatting isn't). Images can also be pasted in from the clipboard, dragged from another PageMill window, placed through a standard dialog box, or (if in one of the supported image formats — PICT, GIF, or JPEG) dragged from the desktop.

Creating links is fairly straightforward, though a bit limited in this initial release. You can link one PageMill document to another by dragging the page icon from the first document window on top of highlighted text in the second. However, this requires that you have both documents open within PageMill, which means both will be converted to PageMill format — something you may wish to avoid if you don't want the original markup to be changed behind your back, as we'll see in a moment.

Alternately, you can type URLs manually into the ATTRIBUTES INSPECTOR or into the LINK LOCATION BAR at the bottom of the document window. You can also drag links straight into the LINK LOCATION BAR from an open Netscape window (Fig. 4), which avoids the problem of having to type (or even know anything about) the destination's URL. This is a very cool feature. However, as in the case of PageMill's other impressive drag-and-drop features (such as dragging graphics from Photoshop 3.0.4 or later), it helps to have a sizable monitor.

Semantic HTML tags such as DEFINITION LIST and EMPHASIS are available either through the menus or from within the ATTRIBUTES INSPECTOR, as are basic formatting commands such as CENTER and BOLD. You can insert horizontal rules from the toolbar and then resize them by clicking and dragging their handles in the document window. Everything else except form creation is accomplished either through the ATTRIBUTES INSPECTOR (where you can set page attributes such as background and text colors using Apple's Color Picker) or within the image view window that pops up when you double click on a placed image (Fig. 5).

Figure 4. A 15-inch (or larger) monitor helps a great deal in working with PageMill's drag-and-drop features.

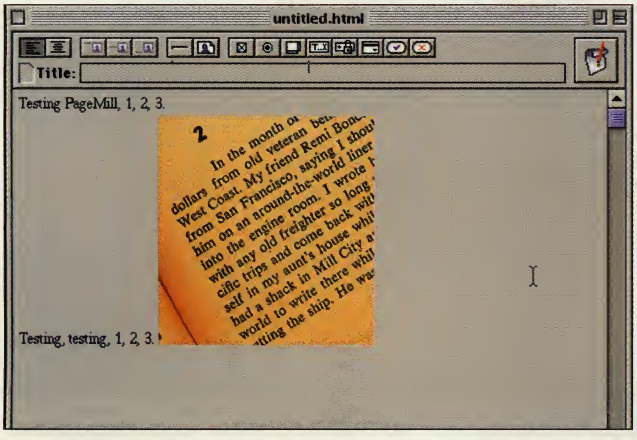


Figure 3. Having inserted an image, if you expect the text to wrap as it would in a page layout program, you'll be surprised.

The image view window integrates a number of features heretofore found only in separate Macintosh applications, most of them (such as WebMap) still shareware. Imported PICTs are instantly translated to the universally supported Graphic Interchange Format (GIF). From there, you can draw hot regions for imagemaps, select a transparent color (making it invisible against the page background), and turn on GIF interlacing (which produces a "venetian blind" effect as the graphic loads in a browser). The image view window also handles placed 24-bit JPEGs, though transparency and interlacing aren't available for that format.

PageMill's image handling tools are quite good compared to the standalone shareware counterparts and likely to improve even further now that Adobe is developing the program.

PAGEMILL 1.0

(Adobe acquired PageMill from Ceneca Software a season before releasing it.) However, you don't want to throw away your copies of Photoshop and DeBabelizer just yet. In converting PICT files to GIF, an 8-bit format, PageMill does a mediocre job of dithering, yielding results (unsurprisingly) inferior to those of Photoshop (Fig. 6). Certain sorts of images, namely those with strong lines and solid blocks of color, fare better in GIF format and are easier for PageMill to digest. These are the sorts of images a user will likely come to prefer.

More impressive is PageMill's handling of background images, which tile behind the rest of a Web page's content. Here the WYSIWYG interface really shines, enabling you to drag an image into a box within the ATTRIBUTES INSPECTOR and immediately view the result onscreen (Fig. 7).

Unfortunately, the ATTRIBUTES INSPECTOR disappears whenever PageMill is in the background, so if you want to drag an image into the INSPECTOR, its icon must be immediately visible on the desktop (again, a big monitor helps), and you must be careful to grab and drag it without actually switching into the Finder. The alternative is to drag into the PASTEBOARD, which survives in the background.

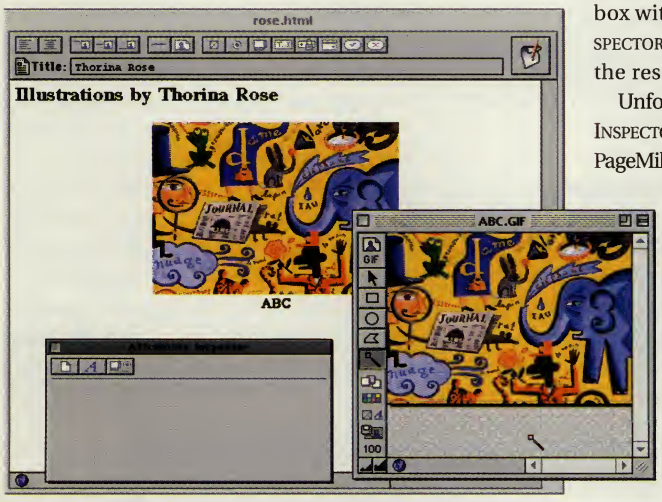


Figure 5. PageMill's image view window, which pops up when you double-click on a placed image, allows you to create imagemaps, select a transparent GIF color, and choose whether or not to interlace the image.

Forms Support

Whether PageMill is worth the $99 street price depends on whether it will save you that much time and frustration. For many, the program's fill-out forms support alone will justify the purchase.

In terms of tedium, forms are a cut above most other HTML constructs, but at least roughing them out with PageMill is a breeze. (You may need to go back and fix or enhance the code with a word processor, but that's true of most PageMill hypertext.) You can insert any of the numerous possible form elements — text fields, buttons, check boxes, menus — with a click on the toolbar, and fields are easily resized by clicking and dragging.

Let's say you want to add a page to your site allowing visitors to request more information in one of four languages. The best way to start is to type in, on separate lines, each of the distinct pieces of information you'll need, say, Name, Email Address, Mail-

PROS AND CONS

Pros

Elegant interface; produces highly compatible HTML documents with consistent results across a range of browsers; an easy way to rough out Web pages; good built-in imagemap and form editors.

Cons

Limited to HTML 2.0 plus a few Netscape tags; inconsistent implementation of drag-and-drop; produces slightly broken HTML; occasionally fails to interpret correct HTML 2.0; rewrites (and sometimes breaks) HTML created by other applications and wipes out text formatting; files are difficult to edit later with a text editor; crash-prone.

Bottom Line

Good for the novice and useful to anyone who deals heavily with imagemaps and forms, but current limitations and bugs will frustrate everyone else. Wait for version 1.1 at least.

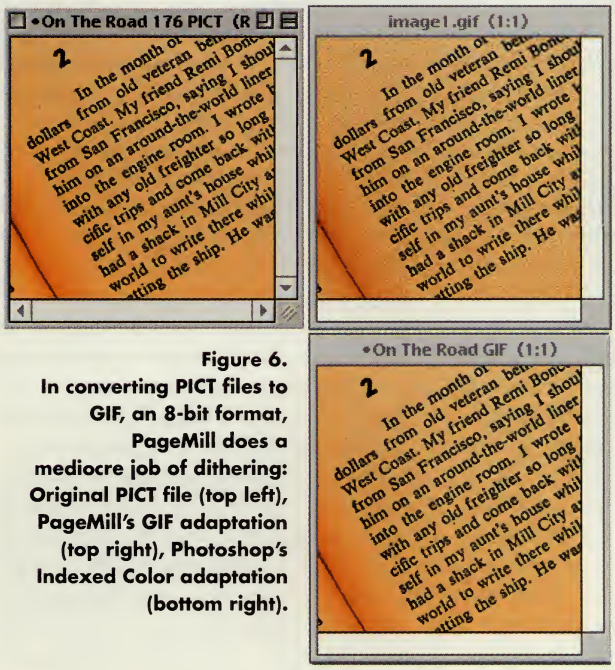


Figure 6. In converting PICT files to GIF, an 8-bit format, PageMill does a mediocre job of dithering: Original PICT file (top left), PageMill's GIF adaptation (top right), Photoshop's Indexed Color adaptation (bottom right).

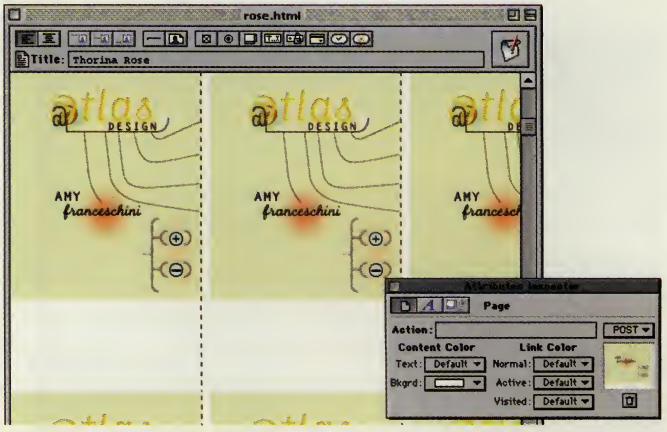


Figure 7. Dragging an image from the desktop into the background image well of the ATTRIBUTES INSPECTOR produces an immediate result in the editing window.

Figure 8. To add a page to your site allowing visitors to request information in one of four languages, start by typing, on separate lines, each of the distinct pieces of information you'll need.

ing Address, Language, Operating System, and Comments (Fig. 8).

The Name and Email Address categories require single-line editable text fields, which you insert by positioning the cursor after each title and clicking the INSERT TEXT FIELD button on the toolbar. Mailing Address and Comments, on the other hand, require multiline text areas, an adjacent choice on the toolbar. Once you've placed the fields, you may select and resize them at will (Fig. 9). *Text fields* (one line each) can be enlarged into *text areas* (several lines) if necessary.

Language and Operating System could also be editable text fields, but you'll probably want to limit the choices, partly to prevent typos. Let's say that for Language you decide to use a pop-up menu listing four options: English, Spanish, Chinese, and Japanese. In the toolbar, click on the POPUP button, thus inserting a menu, and then double-click on the first item. This reveals the contents of the list, initially given generically as ITEM ONE, ITEM TWO, and ITEM THREE; you can edit these terms and add others simply by hitting return at the end of a line (Fig. 10). Finally, you can drag the pop-up arrow to the choice you wish to set as the default.

For the Operating System category, you might wish to offer a set of radio buttons, which is a little trickier than a pop-up menu. By definition, only one button in a group may be selected, but to create a group, first you must insert a single button and then clone it via copy and paste rather than inserting new buttons from the toolbar. Then you can enter labels by positioning the cursor and typing, and define the value for each button within the ATTRIBUTES INSPECTOR (Fig. 11; see page 83).

The final step is to provide buttons allowing the user to either submit the form to your server or clear it and start over. This is accomplished, once again, through the toolbar, and the button labels may be edited onscreen. With the addition of a header, explanatory text, and some formatting, the form is complete (Fig. 12; see page 83). Or rather, nearly complete, since you still need to specify in the ATTRIBUTES INSPECTOR an *action script* (the path to the CGI script set up to process the form) and a *form method* for the page (either GET or POST).

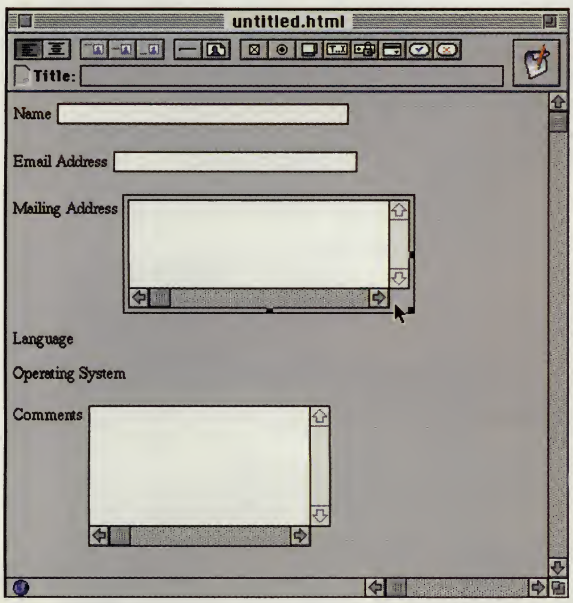


Figure 9. Fields that require multiple lines of text can be selected and resized at will.

For the action script, PageMill's manual sends you to "the programmer developing the CGI script," assuming such a person exists. (In practice, most Web authors will have access only to standard scripts supplied by their Internet provider.) On the difference between GET and POST, the manual is largely silent, except to say that "you should choose Post...because it imposes no limitations on the amount of information you can send to the server."

In case you're curious: POST is preferable because it passes the form data directly to the action script, or to a temporary file of unlimited size, which is then read into the script via standard input. GET is more limiting since the form data must be handled first by a shell script, which stores it in an environmental variable. The problem with this, besides involving Unix in the first place, is that variables can hold only a limited number of characters.

Though documentation of such options is slim, PageMill's WYSIWYG form creation tools can save an awful lot of time and program switching. Along with built-in GIF conversion and imagemap editing, this feature makes the program useful even to experienced authors.

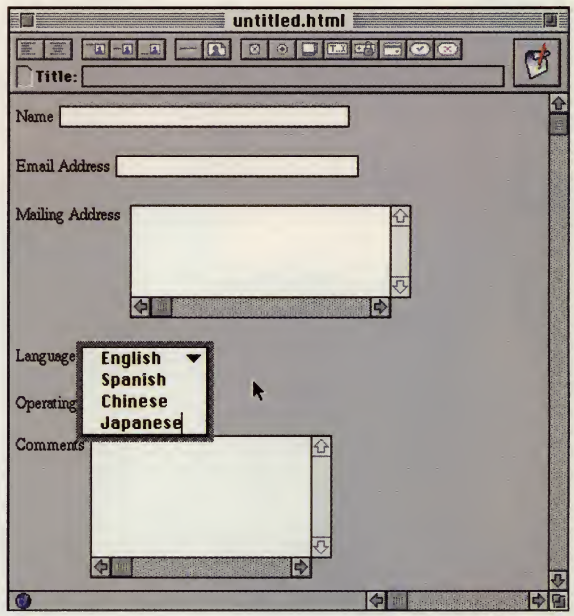


Figure 10. To create a pop-up menu, click on the toolbar's POPUP button to insert the menu and double-click on the first item. This reveals the contents of the list, which you can edit simply by hitting return at the end of a line.

Limitations

Nonetheless, there's a great deal PageMill can't yet do. If you've been inspired by well-designed Web sites and would like to implement some of the cooler things you've seen, you may be in for a disappointment. In pursuit of consistent results across platforms and browsers, Adobe has limited PageMill's capabilities mostly to the HTML level 2.0 standard, now a few years old. This means the program is incapable of handling such things as tables and image spacing attributes, which are pretty much essential to real design for the Web.

Adobe *has* adopted certain enhancements to HTML implemented by Netscape for its Navigator browser, but only elements (like backgrounds and text colors) that, if they're

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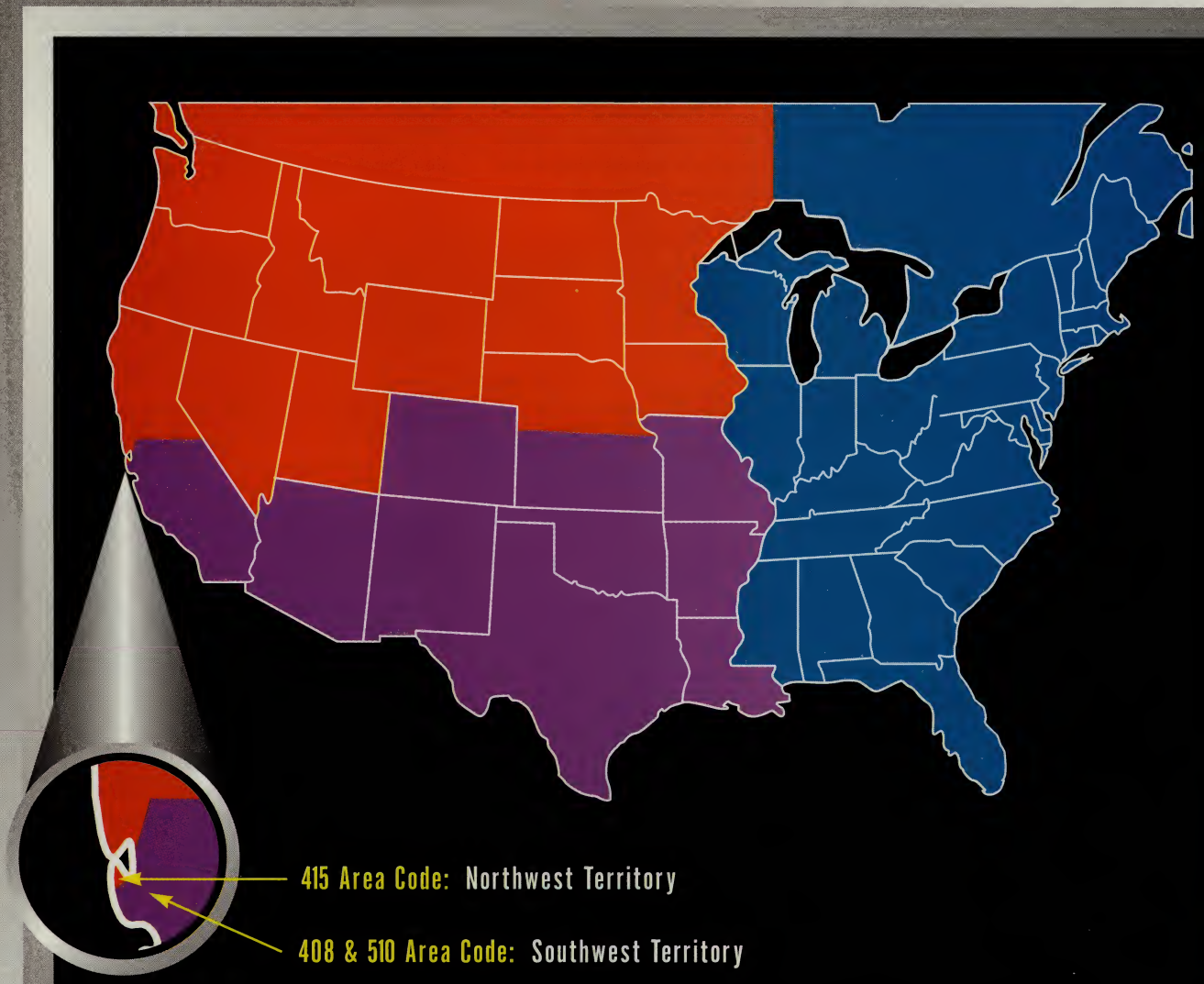

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Microsoft	194	82	206.882.8080
Miracle	189	82	315.265.0930
Murray Altheim c/o Spyglass	188	82	617.864.5524 x201
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Aspen	170	74	303.431.4606
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DayStar	172	74	770.967.2077
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Digital	174	74	603.884.5111
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Intergraph	175	74	205.730.2000
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NeTpower	110	19	408.522.5199
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STRATA MEDIA PAINT	10	19	801.628.5210
TERRAN INTERACTIVE	39	93	408.353.8859
U LEAD SYSTEMS	15	87	310.523.9396

PAGEMILL 1.0

ignored, don't affect the placement of page elements. Thus PageMill documents are structurally identical when viewed with advanced browsers (such as Netscape Navigator 2.0 and Microsoft Internet Explorer) or with less capable browsers (such as NCSA Mosaic 2.0 and the America Online Browser).

PageMill's emphasis on consistent page display is one of its strong points — what you see usually is what you'll get — but it does lead to certain abuses of HTML, which was originally designed as semantic markup independent of visual display. For example, the HTML heading tags — <H1>, <H2>, <H3>, and so on — are supposed to mean "most general," "more specific," "even more specific," etc. In PageMill, they become font attributes (LARGEST, LARGER, LARGE, etc.). True, change of font size is the most evident visual result of using these tags, but that's only because most browsers treat head-

PAGEMILL SUPPLEMENTS & ALTERNATIVES

Dozens of HTML editing tools are available, both commercial and freeware. They're useful as supplements to or replacements for PageMill, especially if you intend to work with advanced HTML. Here's a selection of the more functional and/or popular tools currently available for the Mac.

Bare Bones BBEdit ($119 or freeware BBEdit Lite version): The choice of hard-core Mac-based authors, BBEdit is a powerful text editor that now comes bundled with Lindsay Davis' BBEdit HTML Tools, an excellent set of macros and utilities. (An especially useful component is the PageMill Cleaner, which corrects most of PageMill's bad markup.) Using BBEdit requires some knowledge of HTML, but if you're serious about publishing on the Web, that's unavoidable.

• Bare Bones, Box 108, Bedford, MA 01730-0108; vox 508.651.3561; fax 508.651.7584; Web http://www.barebones.com/; email info@barebones.com.

Reader Service #186

SoftQuad HoTMetaL Pro ($195 U.S., $245 Canada, or freeware HoTMetaL version): SoftQuad is the industry leader in SGML tools (Standard Generalized Markup Language, parent of HTML). Though it doesn't have the prettiest interface, HoTMetaL produces the most rigorous code, and the Pro version includes built-in validators for several HTML Document Type Definitions. Numerous palettes provide quick access to tags, elements, and entities. HoTMetaL also sports a sophisticated table editor.

• SoftQuad, 56 Aberfoyle Crescent, 5th Fl., Toronto, Ontario M8X 2W4 Canada; vox 800.387.2777, 416.239.4801; fax 416.239.7105; Web http://www.sq.com/; email sales@sq.com.

Reader Service #187

Murray Altheim's HTML.edit (freeware): A HyperCard application with a lot of power but a somewhat strange interface. Supports many HTML 3.0 elements — more than any other Macintosh tool — and offers procedures for managing collections of pages. Like most HyperCard projects, HTML.edit is slow to load and to quit, but it's interesting to use once you've got it running.

• Murray Altheim c/o Spyglass, 118 Magazine St., Cambridge, MA 02139; vox 617.864.5524 x201; fax 617.864.4965; Web http://www.stonehand.com/murray/htmledit.htm; email murray@spyglass.com.

Reader Service #188

Miracle World Wide Web Weaver ($50, $75 with one year of support and updates): An easy-to-use, semi-WYSIWYG HTML 2.0 editor that employs scads of dialog boxes to guide you through file creation. It also includes a table editor. The interface, with its numerous editable palettes, is flexible but also a bit cluttered. A demo version is available online.

• Miracle, 118 Leroy St. D4, Potsdam, NY 13676; vox 315.265.0930; fax 315.265.1162; Web http://www.northnet.org/best/Web.Weaver/WWWW.html; email best@northnet.org.

Reader Service #189

Rick Giles' HTML Editor (shareware, $25): Basically a GUI for HTML macros. Supports the 2.0 tags plus tables and a few Netscape extensions. Relatively popular, for shareware, but not very powerful.

• Rick Giles, Box 207, Acadia University, Wolfville, N.S., B0P 1X0 Canada; vox 902.542.7339; Web http://dragon.acadiau.ca/~giles/HTML_Editor/Documentation.html.

Reader Service #190

Jorchen Schales' Webtor (freeware): An uncluttered, strict HTML 2.0 composer and editor with built-in SGML parser. Will choke on most of the HTML you find on the Net these days.

• Jorchen Schales, Web http://www.igd. fhg.de/~neuss/webtor/webtor.html.

Reader Service #191

Second Look Arachnid (freeware): The only other WYSIWYG tool currently available for the Macintosh, but at this point a waste of time. After years of development at the University of Iowa, Arachnid is still arcane, unstable, and barely functional.

• Second Look, Web http://sec-look.uiowa.edu/about/projects/arachnid-page.html.

Reader Service #192

Netscape Navigator Gold ($79): The Macintosh version of Netscape's browser-*cum*-HTML editor is lagging behind its Windows counterpart, in beta as we go to press. Netscape is short on good Mac developers.

• Netscape, 501 E. Middlefield Rd., Mountain View, CA 94043; vox 415.528.2555; fax 415.528.4124; Web http://www.netscape.com/.

Reader Service #193

Microsoft Internet Assistant ($TBA): Long-promised but not-yet-delivered wizard for Microsoft Word 6.0 for the Mac. (Users of the Windows version appear to be happy.) It will help translate Word files into HTML, basically through manipulating style sheets. More interesting is FrontPage, a WYSIWYG authoring tool developed by Vermeer, now a Microsoft subsidiary. Beta versions are said to be coming soon.

• Microsoft, 1 Microsoft Way, Redmond, WA 98052; vox 800.936.5700, 206.882.8080; fax 206.936.7329; Web http://www.microsoft. com/.

Reader Service #194

ings that way, not because that's what the headings truly mean. In other words, PageMill bases its editing tools not on the underlying language, but on the way browsers interpret it.

This copy-of-a-copy mentality will only really offend HTML purists, since anybody doing anything interesting on the Web already thinks of markup as a primitive page-description language. On the other hand, it can easily lead to bad decisions and broken HTML.

The most notorious result — which Adobe surely will fix in a future version — is that the paragraph tag <P> is completely abandoned. (PageMill even strips out <P> tags from clean imported text!) Now, in HTML, <P> has a particular purpose — it signifies the beginning of a new paragraph. As you can imagine, it's a very common and very important tag. But since its usual visual interpretation is a blank line between two blocks of text, PageMill goes for that blank line regardless of the text's intended meaning. Not all browsers interpret the tag the same way, so the tag must go. Ironically, PageMill's replacement — two consecutive line breaks — isn't interpreted consistently, either.

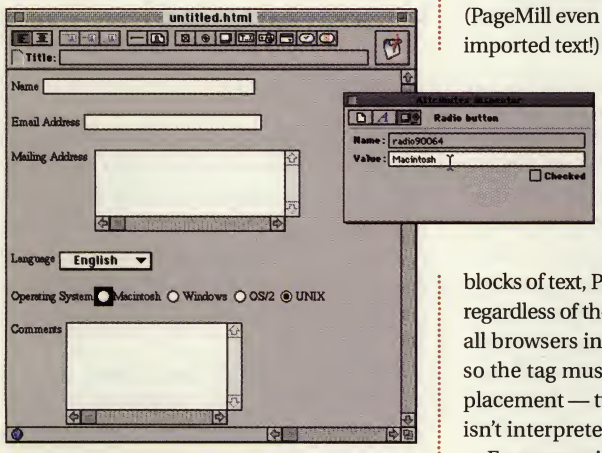


Figure 11. To create a radio button group, insert a single button from the toolbar and clone it via copy and paste (rather than inserting new buttons). Then enter the labels by positioning the cursor and typing, and define the value for each button within the ATTRIBUTES INSPECTOR.

Even assuming you can live with the flawed code and limited capabilities, there's the more serious issue of general instability. PageMill is crash-prone, especially on Power Macs, and especially when launching or quitting. (Unpatched traps and memory collisions are the most frequent culprits.) There are also numerous bugs and inconsistencies — so many that Adobe has posted no fewer than 37 technical notes on its Web site (http://www.adobe.com/Support/). On my Power Mac 7500/100, for example, PageMill almost inevitably crashes when I attempt to quit if other applications are running in the background, completely hanging my system and forcing a reboot. Reports of similar problems abound on Internet newsgroups and mailing lists.

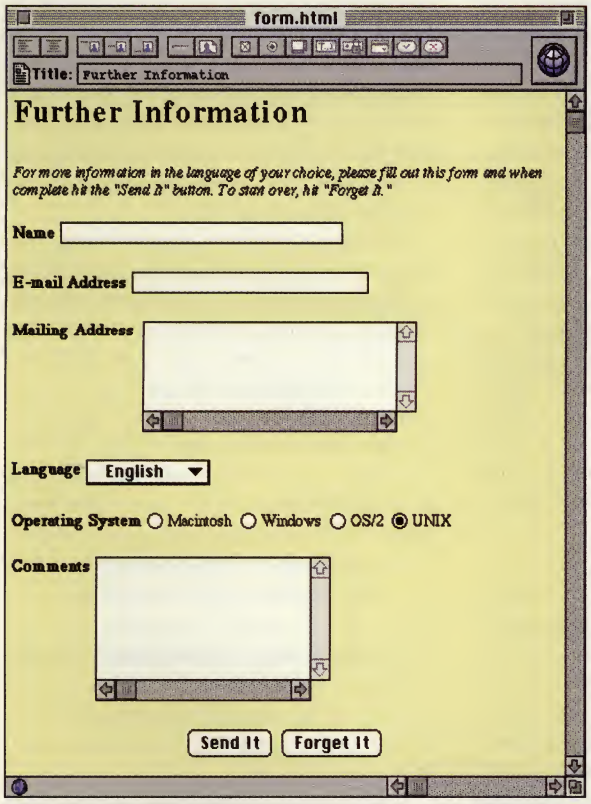


Figure 12. The finished form, complete with header, explanatory text, and buttons, allows the user to either submit the form to your server or clear it and start over.

There are other indications that the program was rushed to market. When saving a JPEG image or imagemap, for example, you are liable to receive the error message, "You don't have access to the specified volume or folder." Apparently, this is because PageMill doesn't like running in low memory (that is, when it's opened before other applications). However, if you open other applications first — one of Adobe's proposed solutions — then PageMill is more liable to crash on quitting. Adobe promises a patch to bring the program up to version 1.0.1, possibly fixing these problems.

Despite its failings, for the moment PageMill is the only program on the market that meets a pressing need for painless, GUI-based Web page creation. (Netscape's Navigator Gold may end the monopoly, but beta versions aren't all that impressive.) Adobe sold more than 30,000 copies in the first month, and as of this writing, it's MacWarehouse's top-selling piece of software. Adobe has a great track record, and when it begins seriously developing the program, PageMill could well become an indispensable tool for neophytes and Webmasters alike.

ADOBE PAGEMILL

Description
WYSIWYG Web page authoring tool.

System Requirements
Minimum: Apple Macintosh II or better running System 7.x, 4-bit grayscale display, 3MB RAM free, 1.5MB on hard disk. Recommended: Power Macintosh or 68040 Macintosh, System 7.5 or later, color monitor, 6MB RAM free, 1.5MB on hard disk.

Features
WYSIWYG editing environment; drag-and-drop image placement and linking; imports GIF, JPEG, and PICT file formats; automatic creation of interlaced/transparent GIFs; built-in imagemap editor; forms support (limited to one per document).

Suggested Retail Price
$149.

Contact
Adobe, 1585 Charleston Ave., Mountain View, CA 94043; vox 800.833.6687, 415.961.4400; fax 415.961.3769; Web http://www.adobe.com.
Reader Service #195

ABOUT THE AUTHOR

Michael Macrone designs Web pages and maintains a site at http://www.well.com/user/macrone/. He has also written numerous books on literature and the history of ideas.

The Virtual Video Deck

A Full-Motion Video Card Won't Make You an Artist, But It Can Make Your Life a Lot Easier.

BY CHRIS MEYER

It's common for video card manufacturers to show a video created by some accomplished artist or special effects house and say, "See? This is what you can do with our card." The reality is that video cards are much closer to a video deck than an artistic tool. However, a good video card is a video deck that happens to be compatible with the way a computer-oriented video producer, editor, or artist prefers to work — which makes it easier to get art out and paychecks in. The trick is finding a card that's most compatible with the way you want to work.

The most common uses of desktop video are editing, acquiring material for CD-ROM, and creating video motion graphics and special effects. At CyberMotion, we specialize in the latter and use our digital video cards (two Radius VideoVision Studios and a Telecast) to capture video, perform full-motion tests of works in progress, make VHS proofs for clients, and occasionally even output finished material to our Betacam SP deck. The savings in time and out-of-house transfer fees have been considerable. Below, I'll go over some of the criteria we use when judging the best card/computer video deck for our uses. I'll note up front that the perfect video system does not yet exist, but at least I can make you aware of some of the tradeoffs. Keep in mind that your needs may not be the same as ours.

The Checklist

QuickTime Compatible. Some desktop video editing products treat their hardware and software as a closed, self-contained system. This is fine for an editing system, but not for our work, where we use several different pieces of software and need to maintain compatibility among them. Some editing systems have the ability to translate between QuickTime and their own native format, but often at the cost of duplicate data and time-consuming conversions. For example, the Data Translations Media 100 requires data-duplicating conversion between their format and QuickTime if the frame rate is anything other than 29.97fps (which is fine with us, since we work at 29.97; you may prefer to work at 30fps). If you make your movies at 29.97, then no duplication of data is required. Avid systems tend to need translations to and from their own format. Conversely, Radius and Truevision use QuickTime as their native format.

Scalability. I can't imagine working on only one computer. There are two of us so we have two workstations, allowing us to work at the same time, and we have a third computer for rendering. Sometimes we work with freelancers and need to exchange data with them as well.

Some older video cards must be installed before your computer can read and write their images, even if they are QuickTime compatible. This can quickly get expensive. A compromise is to put lower-cost versions of these cards in computers used just for proofs and rendering, and place a full-blown system only in the computer used for captures and final output. This is what we do with our VideoVisions; you can accomplish the same result (albeit at higher price points) with variations of Truevision's Targa and DT's Media 100 systems — especially when Data Translations releases their hardware-only card, which costs much less unbundled from their editing software.

Even better is to have a *software codec*: a software imitation of your card solely for the purposes of reading and writing data in the proper format. You can place this in lieu of a card in rendering stations and give it to freelancers you need to exchange data with. You can't capture or play full-motion video with a software codec — there are no hardware video ports, and it's slower than using a dedicated compression chip — but it is very cost effective in a multi-computer facility.

Radius just released their codec, called SoftStudio. Avid features a software codec on some of their lower-end systems. Truevision also has one, but currently it can only read, not write, their data. This is fine for CD-ROM production, where you capture using full-motion JPEG but re-render to a different codec when you're done. But it doesn't help us, where we want to render finished full-motion JPEG movies from ancillary machines.

Synchronized Audio and Video. Audio is central to much of our work. One of our trademarks is tight synchronization between audio and video events. Therefore, perfectly synchronized audio and video are essential to us. Many early cards, such as the Radius VideoVison Studio, did not synchronize these two together. The more recent Telecast does. Avid has launched a very public lawsuit against Data Translations, claiming patent infringement on the way they keep audio and video synchronized. Data Translations claims their Media 100 actually uses a superior technique. Meanwhile, the original NuBus version of the Targa 2000 initially claimed sync, but Truevision has since backed off from this claim. They now say you must get either the Pro version of the NuBus card or the PCI version of the Targa 2000 to have true sync.

Just claiming sync is not good enough: The audio sample rate clock must be hard-slaved to the video clock, and it should be matched up in a manner that follows the SMPTE 272M specification. Not all video cards do. For example, both Radius VideoVision Telecast and Data Translations Media 100 use slightly off-speed audio clocks when trying to match 44.1kHz audio to NTSC video that can result in long-term drift if the audio and video weren't digitized through the same card. Data Translations says this will be corrected in Media 100qx. Meanwhile, the Targa 2000 does indeed achieve correct long-term sync, but sometimes it adds or removes audio samples in the process. Truevision claims to do this in such a way that no audible distortion is introduced. I'll be going into more detail on this in my next column.

Usable as a Second Monitor. We don't want our video card to be strictly an NTSC-compatible tape deck input/output device. We want to use it as a fully functional computer monitor graphics card in addition to our normal 20" displays.

Chris Meyer is a principal in the Los Angeles-based motion graphic project studio CyberMotion. He is also manager of technical research at Roland Audio Development and teaches digital audio at the Hollywood branch of the American Film Institute.

We like to place our main working stage on this monitor to check NTSC colors (which appear differently when they're displayed on an RGB monitor) and safe areas, or to use as an overflow monitor for extra windows and palettes. Many cards can drive a monitor while recording or playing video, but not as a second computer monitor to be accessed by all software.

This capability requires a video card to have some convolution or de-flickering algorithm so that thin lines (such as those that outline most computer windows) don't flicker on an interlaced video monitor. Radius makes the only Mac cards I'm familiar with that feature convolution. The Truevision Targa 2000 can repeat horizontal lines to eliminate flickering, but with half the lines missing most computer readouts are useless.

Special mention does need to be made of the Targa's ability to support both a 20" and NTSC monitor from the same card. This allows it to play full-motion video on the large monitor as well. Usually this is not possible — more typical is the ability to display the video on any monitor, but it can only be played back at full speed on the NTSC monitor. For some, this compensates for not being able to use the NTSC output to drive a fully independent second computer monitor.

Multiple Resolution Support. A common computer monitor resolution is 640x480 pixels. The 480 number is close to the number of active horizontal scan lines commonly required by NTSC video, 486, and the 640 square-shaped pixels across fills out a nice 4:3 aspect ratio like television is supposed to have. Therefore, most desktop video systems (such as the Media 100 and Telecast) deliver an image resolution of 640x480 pixels.

However, this does not pass strict muster for a real video signals. Indeed, the CCIR-601 standard for digital video (used by devices such as D1 and Digital Betacam decks as well as the Abekas DDR) specifies 720x486 non-square pixels. A compromise for square-pixel-oriented computer users is 648x486 pixels, which retains the 486 active scan lines and the 4:3 aspect ratio. Only the Targa 2000 supports all three of these resolutions. The same board is used in the latest generation of Avid systems.

Some PC-based video cards, such as the DPS Perception, support a format of 720x480 pixels. The new prosumer DV standard for digital video seems to use this format, so it's likely not finished in this area. In the meantime, even though I wish Media 100 and VideoVision supported 720x486, in truth, their 640x480 images have already made their way onto broadcast TV multiple times.

One other quirk in the area of multiple resolutions bears mentioning: zooming. If you're working on an editing system, you probably want your images to be full-screen, full-resolution all the time. However, if you're just running off a quick proof to see if your animation moves are correct, you may not have the time to render or create a full-screen test. A useful compromise is 320x240: a quarter of the pixels and often only a quarter of the rendering time. To fill the entire screen for a VHS proof, it needs to be zoomed. Many cards perform this zoom by duplicating pixels vertically and horizontally, which results in a very blocky image. Some editing-focused systems can't even deal with less-than-full-screen video.

The Radius VideoVision features an interpolated zoom that looks much better than usual. Indeed, some video producers have used this format for their final product, trading off fewer compression artifacts (320x240 also requires only a quarter of the data throughput for the same compression ratio) for the softer image and lack of fields. These people claim it has more of a "film" look (really!).

Quality. Of course, the final result has to look good. Good chips must be used for the analog to digital video conversion. Video interconnection formats are also important. Just supporting composite video isn't good enough. Y/C is a bare minimum. Component YUV connections enable us to maximize the video quality we can get out of a Beta SP deck — the most common format for professional video work. As for audio, pro-level analog or even digital audio connections are a big plus. Fortunately, virtually every card now has a component video option. Higher-quality audio connections are much less common.

Intangibles. Is the manufacturer reliable? Do they give good support? Do they admit their shortcomings and work to fix them, providing workarounds in the meantime, or are they too defensive to frankly admit their faults? Does the card itself look like it has a future, or is it likely to become orphaned? Don't forget that a card doesn't stop working just because a newer one is available. But if there are no more software updates coming or no clear upgrade path, it might turn out to be a bad long-term investment.

Bottom Line. As I mentioned up top, there is no perfect card yet, though all have uses. The Radius system comes close to being our own dream system, but it falls short of perfection. We had great hope for the Truevision system when it was first announced, but some secondary issues, such as functionality of the NTSC output, have given us pause. We love the quality of the Media 100 system, but it has been focused more toward editors than people like us, though that seems to be changing.

One thing is certain. Evolution has not stopped. Let's see what appears at the NAB show (happening about the time you'll be reading this). Stay tuned.

DIGITAL VIDEO FOR EDITING

The most well-publicized use of digital video cards in personal computers these days is for editing video. A traditional editing suite requires at least two tape decks: one to play back raw source material and one to re-record just the segments you want to keep. These are usually processed through a video switcher, titler, or effects unit. If you want to have more than one video image playing at the same time, you need an additional source deck per extra image. The number of decks you have and number of simultaneous channels your video switcher supports, limits how complex an image you can create. Remember that even a simple crossfade or wipe consists of two images playing at once. As a result, a traditional editing suite has at least three tape decks.

Digital video cards can narrow these requirements to one deck. You use this deck to play all your source material into the computer, combine whatever elements you want with virtually no restriction on the number of simultaneous images (since all footage can be accessed equally and in any combination once it's stored on a hard disk), and play the finished work back out to the same deck. For this savings alone, digital video can be attractive.

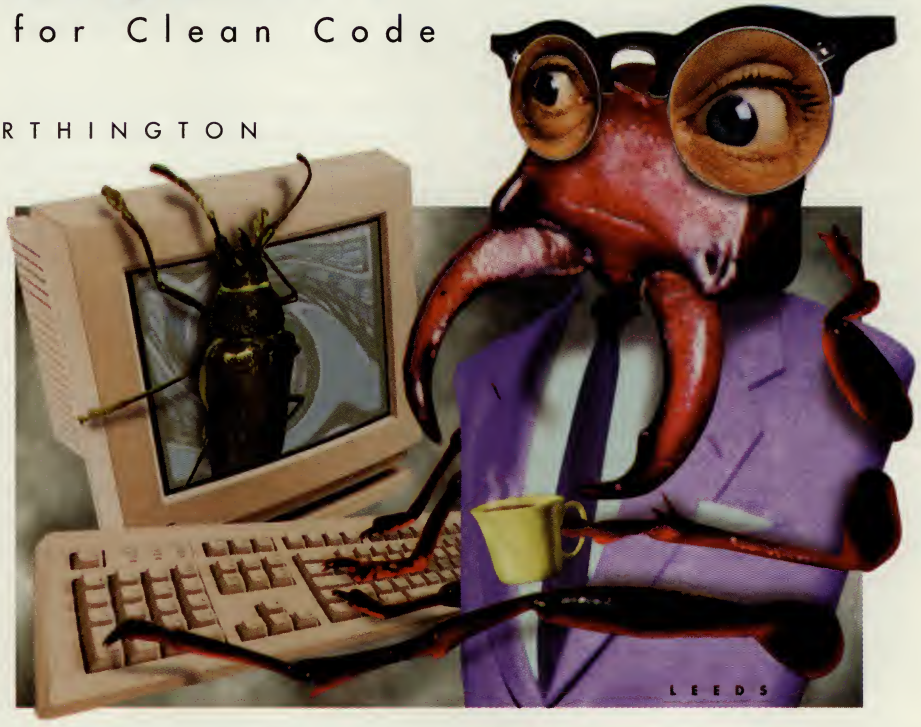
Another benefit of digital video for editing is the ability to maintain higher image quality from start to finish. Professional tape decks have component-level interconnections, but not all the equipment in a typical studio may support component video and may degrade the signal by requiring conversion to a lesser format such as composite video. Dubbing from tape to tape also reduces video quality on each pass. With one component video deck (such as a Sony UVW-1800 Beta SP deck) and a high-end digital video card (such as Radius VideoVision Telecast, Truevision Targa 2000 Pro, or Data Translations Media 100 with the component option), you can have an all-component studio for less than analog-based facilities pay for the tape decks alone.

Mind you, it is still possible to screw up digital video by compressing it excessively. Oh, for the holy grail of uncompressed video in our computers! Or by using software that doesn't maintain the highest possible quality. But the potential exists for enhanced quality at a much lower price.

Getting the Bugs Out:

Hot Tips for Clean Code

BY JOHN WORTHINGTON



I have a confession to make. My name's John and my code has bugs in it. Actually, all programmers have bugs in their code. It's a dirty little secret that the marketing people don't like us to talk about. I feel much better now that it's out in the open.

Some people might tell you their programs are bug-free. That usually means they haven't tested them enough to find all of the bugs. Or maybe they have some swamp land to sell you.

Don't get me wrong. It's not that programmers intentionally leave bugs in their work. It's just really hard to get all the bugs out. They hide in the little nooks and crannies where people other than users never look. Besides, you can always add a new feature or two to your bug fixes and sell it as an upgrade. Just don't tell people you got the idea from me.

Schedules in the Real World

The most basic impediment to writing bug-free code is the schedule. Contrary to what you might think, a project's schedule is not based on how long it's going to take to do the work. Sure, in a perfect world, everyone involved would get together and agree on the feature set. Then, after considering how much work is involved, a realistic schedule would be established. Once the schedule and feature set are finalized, you just get to work.

Unfortunately, in the real world, or at least the one I live in, things work very differently. The schedule is based on the desired introduction date. The feature set is never frozen, and people work madly without sleep until the project ships or until they drop from exhaustion.

Exactly how the intro date is picked beats me. Usually there doesn't seem to be a good reason why the product must be introduced on that date. Let me give you an example. Once I worked on a project where the president of the company decided we had to introduce the product by Labor Day. I'm still not sure why. Perhaps because that day was colored red on the calendar. We didn't have enough time to implement all the features, let alone test the product. Needless to say, it wasn't a rousing success.

What do you do when you're in this situation? That's the tricky part. If you point out that the project can't be done in the allotted time, you'll get a lecture on positive thinking. If you try and fail, it's your fault. If by some miracle (and lots of caffeine) you make it, then the schedule wasn't aggressive enough in the first place. Now that I'm older and perhaps wiser, I try to avoid this sort of project. Get a good feel up front for the scope of the project and the schedule. If you don't think you can do a quality job in the time allowed, don't take the project.

John Worthington is the founder and president of MojoSoft, a company specializing in multimedia technology and development. In his misguided youth, he wrote the Macintosh MIDI Manager and was the project leader for QuickTime. His most recent project is the MusicNet CD-ROM.

Comment Confusion

Another problem with tight schedules is pressure. The old cliché "haste makes waste" is true. Some programmers complain they don't even have time to put comments in their code. Aside from being silly, this is a big mistake for two reasons. First, nothing is more frustrating than sitting in front of the computer, hours away from a deadline, trying to figure out what you were thinking when you wrote a piece of code. Second, it's hard to get anyone else to help out with your code if it isn't commented. Remember, if you are the only person who understands your code, then you'll have to continue working on it. Seems like good job security until you realize that it usually means no new projects and no promotions.

I try to comment the start of every routine in a standard way. This makes it easy for anyone who picks up my code to get a feel for it. Also, nicely organized comments radiate professionalism. This is especially important if you're doing contract development.

Here's an example:

```
/*_____________________________________
   DrawRect: - draws a rectangle
     input:  r - the rectangle
     result:  none

   assumptions:  the rectangle's width
     and height are both positive.

_____________________________________*/
```

Often I'll write all these comments before I start on the code. They serve as a really useful design tool. Later I just fill in the routines.

Perhaps the most important part is the assumptions section. This is where I list any corners I've cut. Even if you're working by yourself, it's hard

ILLUSTRATION: RICHARD LEEDS

to keep all the details of a large project in your head. If you're working with a team, documenting your assumptions is even more important. This documentation can be invaluable when debugging. A large percentage of bugs come from users violating undocumented assumptions.

Suppose the routine described in the comment above were called with a rectangle that has a negative height. If the comment weren't there, you wouldn't know where to look for the problem first. Should DrawRect be fixed so it does the right thing with a negative height, or should the routine calling it be fixed? With the comment, you know the DrawRect routine was never intended to handle this case and that the problem is probably in the calling routine.

Another useful technique is pre-flighting the arguments to your routines. What is pre-flighting? Before pilots take an airplane up, they check everything very carefully. After all, it's a long way down. With software, we check each of the arguments to make sure it's what we expect.

For the DrawRect routine, the pre-flight portion of the code might look something like:

```
void DrawRect(Rect r)
{
  FailNegative(Width(r),err);
  FailNegative(Height(r),err);

  // drawing code omitted

 // control passes to here from
 // FailNegative
err:
 // handle any errors from FailNegative

}
```

FailNegative is a macro that checks its argument to see if it's negative. Why use a macro? Because it's evaluated at compile time, which means we can change the code that gets compiled based on a debug flag. Furthermore, checking each of the arguments can really slow down the execution of your code. Also, you want to print out debugging information while you're debugging your code, but you don't want users to see this.

Here's what the macro looks like. Note that this is a fairly simple version. You can get fancy. The back slash (\) at the end of the lines tells the compiler that the macro is continued on the next line. Without this, the compiler assumes the macro is only a single line.

```
#ifdef DEBUG_IT
#define FailNegative(case)      \
  if (case < 0)                 \
  {
  printf("prob in FailNeg.\n"); \
  goto handler;                 \
  }
#else
#define FailNegative(case)      \
if (case < 0)                   \
 {
 goto handler;                  \
 }
#endif DEBUG_IT
```

I set the flag DEBUG_IT to TRUE if I'm building a debug version of the code and FALSE otherwise. The primary difference is that if I'm building a debug version, then an error message is printed.

Using this basic idea, you can create special macros for a variety of cases. In addition to pre-flighting arguments, you might use them for checking error results. What? You don't check error results? Unfortunately, this is fairly common and a really bad habit.

Here's why. Suppose you need to allocate some memory. The value returned is 0 if the memory can't be allocated. If you don't check for this case, then you'll be writing over low memory locations with unhappy results. If I had a dollar for every time I've seen this, even in shipping applications, I'd be sending this column from somewhere in the South Pacific.

There are going to be bugs in your code. Not much you can do about that. But with a little care, at least you can avoid the obvious problems.

Cool Music Tips for the Sega Saturn

BY DAVID JAVELOSA

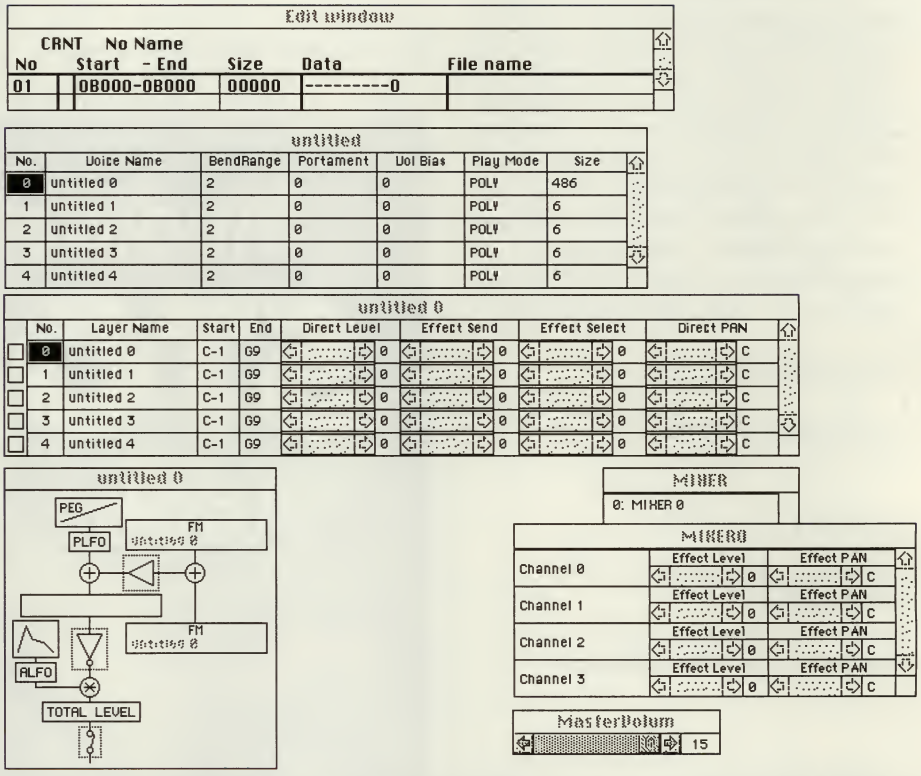
The Sega Saturn is the latest entertainment platform in a long line of venerable video game machines from Sega Enterprises and its domestic subsidiary, Sega of America. In the face of competition — 3DO, Sony PlayStation, and the PC-based CD-ROM sleeping giant, Sega hoped to avoid a predicted market slump and lead the way for the next generation of home game machines, much as the 16-bit Genesis, with its groundbreaking six-voice FM synthesizer and screaming 8MHz 68000 processor, stole the wind out of Nintendo's initial 8-bit kiddie toy, the NES.

Mindful of the elements that contributed to the success of the Genesis, Sega was a seasoned pro in preparing for 32-bit game development. These elements included a strong developer technical support group, well-designed development tools, and delivery hardware designed with as much flexibility as could be afforded in a consumer device.

R. Wiley Evans of Sega's Developer Technical Support (DTS) sees the development battle from the front line. "We get people porting from a PC or PSX (Sony PlayStation) who want to stream everything in the world, but the Saturn is not set up to do that. Its selling point is the dedicated 68000. FM works and it rocks, but you have to have roots in the old school to do FM effectively on any machine. These new whiz-bang sound developers are ticked off that they can't get their 14-second 44.1kHz stereo string samples in and still have full-on dialog and sound effects. A big problem is that producers don't do the research necessary to figure out what they can do *exactly*. They hear rumors about what a certain machine is thought to be capable of, and then they ask for MIDI, PCM, and Red Book all at the same time *with* full-blown graphics. Gimme a break! You still can't do that with a PC or Mac yet."

"Another problem is that the producer says, 'I want to do a multiplayer, 3D action game with Red Book digital audio' then leaves it up to a programmer to figure out how it'll be done without talking to a musician or graphic artist. The programmer says he *thinks* it can happen, the producer says 'Make it so,' and then he jets off to some electronic shows. When the deadline comes around, he comes back to the office and starts shouting at support people and pointing the finger at everyone. Overall, the problem is lack of knowledge transfer between producers, programmers, and artists."

Operational and human communication hassles aside, developing music for next-generation game machines like the Saturn can turn into a vast exploration of compositional possibilities. Let's look at the development system as it relates to sound and the features, libraries, and resources that'll help you make the most of the Saturn platform.



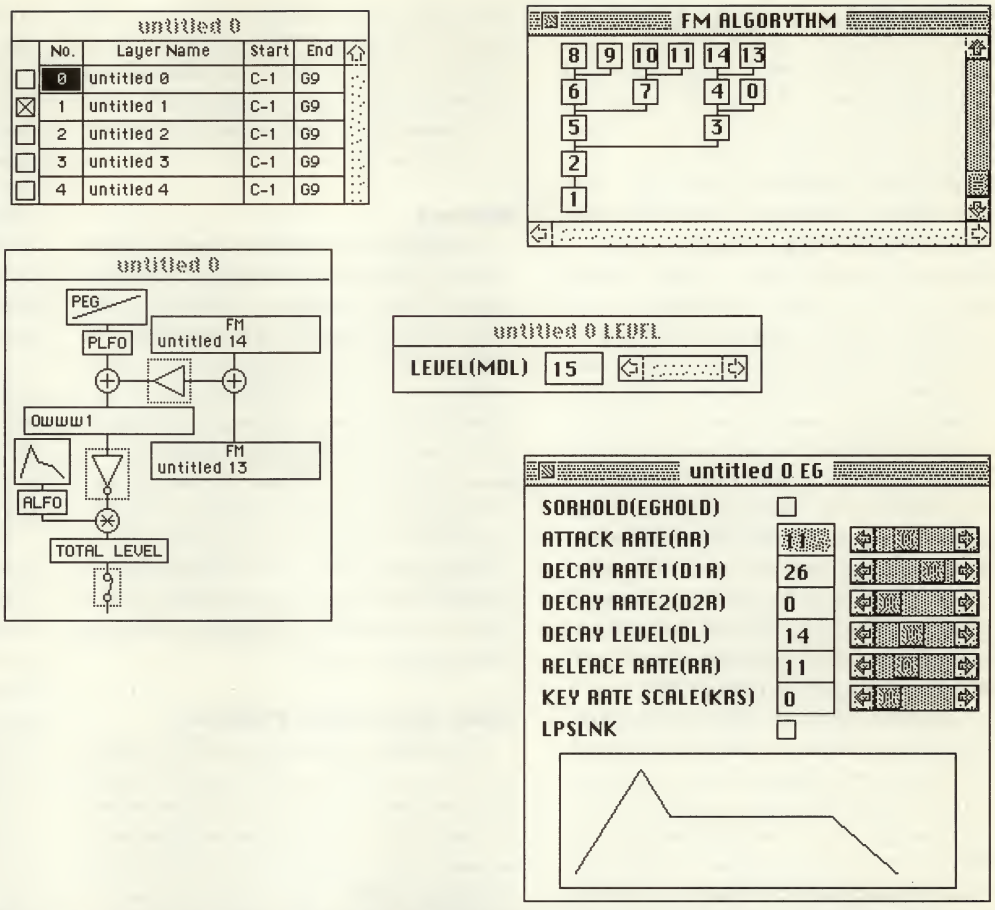
Logically laying out the Saturn Sound Tool windows on a big screen helps to view the process like a commercial music sampler. The top window maps out memory allocation for voices, sequences, etc. Below that is the tone bank window for managing the different instruments and their specific parameters. The layer bank shows how the different physical voices are grouped in an instrument, including register range, level, and pan. The effect select channel is equivalent to a send bus on a hardware mixer. The lower left shows an edit window for an individual voice. A bank of several different "mixers" can be configured. A "mixer" window actually represents effect return busses with level and pan. Also shown: the omnipotent Master Volum(e).

David Javelosa is an independent composer/producer, formerly at Sega and the Voyager Co., and on faculty at UCLA Extension and SFSU's Multimedia Studies Programs. His recent work includes Marvel's CD-ROM Comics, Disney's *Pocahontas* video game, and an Enhanced CD of 31st Century Lounge Music.

The Right Tools for the Right Job

Like other 32-bit game platforms, the Saturn offers several options for sound generation. The most obvious sound source on the system, of course, is the CD player. Since the Saturn is a CD-based system, Red Book audio is available — with all its advantages and disadvantages. One advantage is that it can play high-quality stereo sound as produced in the recording studio. Simple enough. In addition, the pitch of the audio can be adjusted and controlled from the processor, as can individual volume and pan levels for each of the stereo channels. These features present some interesting possibilities for realtime interactive control.

The heart of the system, however, is the custom Yamaha SCSP audio chip, which features 32 voices/channels of PCM sample playback from 44.1kHz/16-bit on down. It also includes programmable internal DSP, a 16-channel mixer with stereo out, and a dedicated 68000 processor to handle the entire audio show. The development tool suite is all Macintosh based, so ideally you only need the one computer for composing, sequencing, voicing, and editing. The audio emulation system supplied to developers is a standalone box with only the soundboard. This differs from development systems that include the entire delivery platform, in whatever variation, soundboard included.



This layout is an overview for creating and editing both FM synthesis and sample based voices. The checked box on the left of the tone bank indicates a channel allocated for FM carrier output. All voices can be used as FM program operators. Below that, a voice edit window shows the sample "Owww1" loaded. Each little box in the schematic click opens to edit windows such as pitch and amplitude low frequency oscillators (LFOs) and envelope generators (EGs) shown in the lower right. The modulation level adjustment (center) introduces frequency modulation (FM) from a mix of up to two other voice/operators. When updated, a map of the voice modulation paths are mapped out in the FM Algorythm window.

The host Macintosh must be hooked up to the soundboard in two ways. MIDI cables coming from the computer's MIDI interface out to the SCSP's MIDI ins provide realtime control of the sound from a Mac-based sequencer or external MIDI keyboard. The soundboard actually has two sets of MIDI in/out/thru connectors to provide access to all 32 MIDI channels.

Strangely enough, the Saturn includes an optical I/O on the board for loading sample data. The designers didn't assume the typical developer would have access to audio digitizing, and this I/O would provide a way to bring in samples from audio CD libraries or DAT players. In reality, most audio developers have full digital audio setups that include their own digitizing and editing environments, such as Digidesign Sound Tools on the Mac. As a result, a WAV editor program that comes with the development tools allows the SCSP to act like a peripheral sound accelerator card.

The other hookup is a SCSI cable to the Macintosh (or the SCSI chain of external hard drives and CD-ROM devices). This connection provides a fast way to download sample data, converted MIDI data, and DSP configurations. Remember, the standalone box is just a means of performing your music and audio. The data you're editing and downloading from the Mac will be compiled and delivered to the programmer assembling the entire game.

For those Sega developers who have a digital audio production setup, this much should have been made clear in the documentation. For outsiders looking to come in, this gives you an idea of some of the tasks involved. There's still time to turn back!

On the software side, the Saturn tools treat the soundboard almost like a commercial sampler. The voicing architecture organizes multiple samples into instruments, and instruments into banks. A familiar analogy would be Digidesign's SampleCell. Similar to SampleCell, all digital audio would be edited on the Mac in something like Sound Tools and saved as AIFF files. Annoyingly, the Saturn doesn't always like the AIFF files that Sound Tools puts out — apparently a problem in the file header information. I've found that importing them into Passport's Alchemy and saving them as AIFF files made the data more palatable for the Saturn board.

Libraries and Resources

Samples can be taken from a number of sources and used in different ways. The most common source is CD libraries that have been developed for the Saturn system. A great set was done for the original developer's kit, and a handful of new libraries will be available in the near future. These libraries feature samples that have already been trimmed, edited, and assembled into instrument files, ready to be loaded into banks.

As a general practice, I use stock instrument sounds for background material and put unique custom sounds into the foreground voices. Likewise, it's a good space-saving technique to put lower sample-rate instruments (read smaller, lower fidelity) in the background and the higher sample-rate instruments in the foreground. If you're importing your own samples, you can configure

parameters such as note range, level, effect send, effect select, and pan at the sample level. These options provide for some very interesting and complex instruments.

After you've assembled your samples into instruments, you can save individual instruments for later work or save the group as a bank for the composition at hand. This will be one of your main components at run time. One of my favorite composition techniques in this environment is to use longer samples of drum loops or other rhythmic phrases. You may need to use a lower sample rate to compensate for using a lengthy sample, but a background sample loop can contain a very complex set of instrument sounds and ambience that leaves the DSP allocation free for unique delays or reverb on the foreground voices. This touches on the strip sample or .mod file techniques I've mentioned using on other platforms (see Interactive Noise, *Inter-Activity*, November/December '95).

One glitch to watch for when using this technique is timing. When sending the MIDI stream to trigger loops and play instrument samples, you're syncing to the external sequencer's tempo. After you convert and download the MIDI file to the SCSP, the performance tempo from the internal playback can differ greatly enough to make your loops sound truncated or out of sync. This must be fixed by ear, adjusting the tempo in your original MIDI file before making another conversion. This tempo discrepancy has been noted and reportedly has been worked on. However, I've noticed similar problems on the Sony PlayStation.

Memory

Here's another tip regarding memory. The development system has a whopping 2MB RAM, whereas the actual target system is shipped with 512k. This little design feature was an attempt to be kind to the music developers creating their masterpieces — the idea was that after all was played and done, data compression would clean up the mess. This is a friendly notion, but the composer should always be aware of eventual limitations, try not to assume compression will always be available, and be as nice to the programmer as possible. Also, bear in mind that precious audio RAM has to hold everything, including samples, DSP and instrument configurations, converted MIDI data, and so forth.

Other Fun-Packed Features

Because of the open architecture in the sample playback, the sound system is suited for streaming audio alone or interleaved with video. As Yellow Book audio, the quality can exceed industry standards (48kHz) but that presents an even bigger storage problem. The 32 voices and 16 mixer channels can handle multiple streams of this audio data, but bandwidth limits the size (sample rate) of what's coming down the pipes.

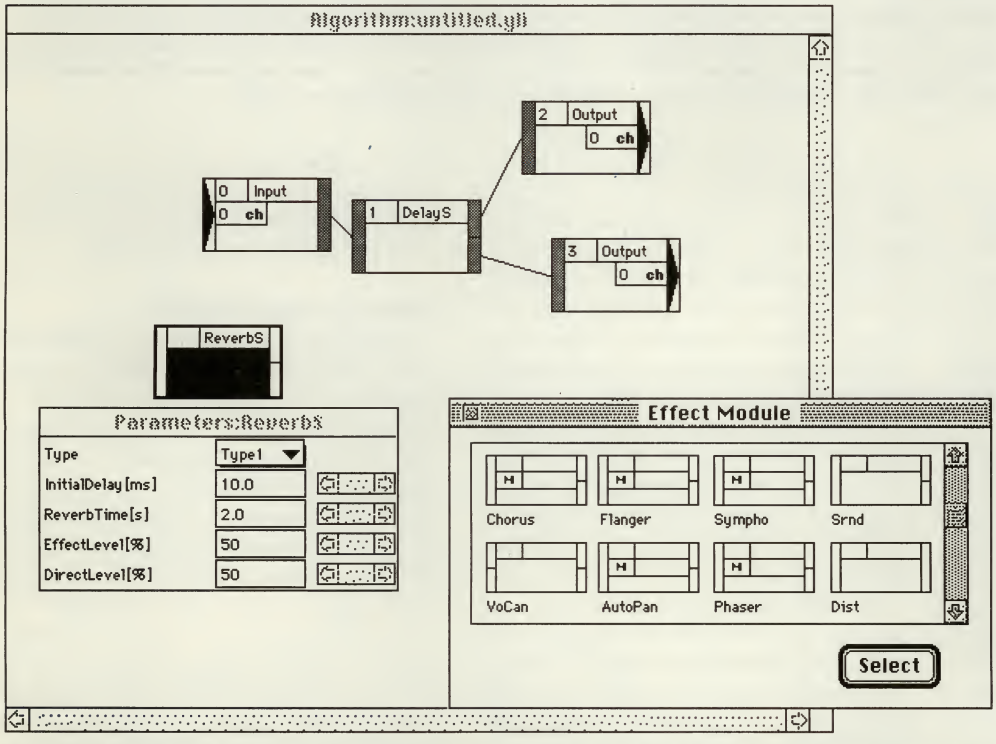
This scheme would be useful for a scenario in which the user is switching around time-specific clues coming out of a multi-channel radio and the game is dependent on listening to the right channel at the right time. Another application for high-quality streaming audio might be on-the-fly editing of music, such as an interactive scenario, branching seamlessly through different segments of a piece of music. Again, maxing out the data stream, sound channels, and processor capacity influences game play and graphic presentation. If the audio scheme goes beyond the dedicated 68000's capabilities, the main CPUs (Hitachi SH-2s) can be called in to add some muscle, but this is a serious invasion into the overall program design.

The DSP, combined with the mixer, does a great job of tying all the sound elements together. Samples, streaming audio, FM, and even CD audio can be run through internal DSP effects. The open architecture really shines with several different algorithms available and a cool patch-cord style interface for configuring them. Each of the effect algorithms take up processor cycles, so you won't have all of them running at once. A good reverb can take up so many steps there won't be much left after that. Q-sound spatialization is another great realtime effect available on the Saturn. The Saturn's DSP can also be programmed to handle audio data compression, giving it an advantage over the PlayStation's hardwired compression scheme.

One of the least talked about but most likely resorted to features on the SCSP is FM synthesis. Giving up at least four PCM voices at a time as FM operators, the Saturn actually works as one of the most versatile FM synthesizers in any game machine. By throwing more voices at an FM patch you can even get eight-operator FM synthesis like the venerable Yamaha DX7.

The advantage here, of course, is the relatively minuscule amount of data it takes to sound an FM patch versus sample data. Sweetened with the internal DSP, FM instruments can easily save the day in a pinch. I've heard talk about a certain sound designer putting together a 32-operator patch just to say it could be done! This makes me think that Yamaha probably will put this SCSP chip in a commercial synthesizer in the near future.

The Saturn offers composers plenty of possibilities. Memory constraints, however, are a cold hard reality. My favorite translated-from-Japanese dialog box in the Saturn sound tool appears when you try to import a sample that won't fit into memory: "This data is BIG data!!"



The DSP editor is similar to what you would find in an exotic effects editor like TurboSynth. Using a modular patching metaphor, I/O modules and effect modules are called up from scrolling select palettes. Once on the screen, just connect the boxes. Clicking on an effect module reveals parameter values for editing. The input module channels refer to the effect, select sends in the layer bank, and the output module channels return to the mixer's effect levels and pans. If you think about it, it makes perfect sense. Really.

This is the End

The State of the Art in SGI Alias/Wavefront Graphics

BY MARK GIAMBRUNO

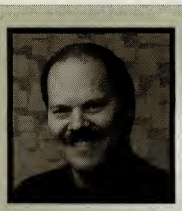
Every year at the Association for Computing Machinery's Siggraph show, people clamor for tickets to the hottest event—the Electronic Theatre. The Theatre covers the fields of motion picture effects, commercials, scientific visualization, and fine art, showcasing the top animation works of the year. This year's grand finale animation was a piece titled *the end* created by Chris Landreth and his Alias/Wavefront team.

The Product

the end takes a satirical look at the sometimes overly serious works that have graced Siggraph shows in the past, including some of Landreth's own works. It also showcases some of the latest advances in Alias/Wavefront software, including special effects, lip syncing, and realistic hair.

The animation begins with a pair of digital performers materializing on a chessboard-like stage. The characters' heads are fractured, with rods and wires protruding from the male's head and widely spaced but realistic hair adorning the female's. The bodies are even stranger, looking like a loose collection of oversized veins with long tendrils dangling from the arms. It's as if a person's cardiovascular system decided to dump the rest of the body and strike out on its own.

The characters begin to dance, hair and tendrils flowing behind them hypnotically. Then they pause to make profound-sounding statements such as "Lingering narrative concepts and furtive simplistic montage are the harbingers of the new semiotics!" This exchange culminates with the characters hopping from foot to foot chanting, "Speak to me now, bad kangaroo."



Mark Giambruno is the creative director of Mechadeus' first two multimedia titles, *Critical Path* and *The Daedalus Encounter*. Current leisure activities include learning to read and write Japanese, playing *Hexen*, and plotting to seize control of the planet.

The performance ends and animated house lights come up. After an uncomfortable pause, the male character turns to the female and asks, "Well, what's next?" She replies that she doesn't know either, and the characters begin to wonder aloud where they are and what this is all about. In the background, a voice can be heard carrying on a phone conversation. The characters take note and one says, "Am I hallucinating, or did you just invent God?" The voice replies, "I'm not God. I'm an animator. This is an animation. You are characters in this animation."

Digital performance artists gambol on a virtual stage in *the end*. The dancing characters were animated via motion capture, and their fibrous bodies were generated using CompuHair, a new module in Alias PowerAnimator 7.0.

The characters, awestruck by this revelation, start to quiz the animator about their appearance and surroundings. "What are these sticky things? And the rods and wires in my head? Why don't we have ears? What are those hand-bird things?" The animator replies that they are metaphors, enhancing the hip artistic content and profound nature of the piece.

Finally, the female starts to get upset, challenging the animator's explanations and formulating one of her own. "If anything, *I* am creating *you*. You have no choice but to create this animation, okay? *I have free will!*" At this point, her image dissolves into that of a frame on a storyboard, with a lifelike human hand writing the words, "I have free will!"

The animator appears at his desk, working on the boards and continuing his phone conversation. He describes the concept behind the work and his ideas for a couple different endings. The party on the other end of the line disagrees, telling him to ditch the two characters and make the ending about *himself*. That he, the animator, is a work of fiction in his own animation, and that he changes continuously without even realizing it. As the animator discusses this idea, he begins to change — his hair, voice, skin color, and even gender cycling through permutations as he discusses that very possibility.

Finally, he becomes a young Asian-American girl as she says, "Then I realize that as a work of my own fiction, I can create my own ending." With that, the girl's image transforms into the final frame of the storyboard.

The Process

Landreth's roles in the project were varied, but co-writing and directing the piece were two of his primary tasks. Despite *the end*'s complexity and new techniques employed, Landreth says that coming up with the story was the hardest part. This is reflected in the finished product itself, since much of it deals with the process of developing its own story.

The motion capture was performed at Wind-

light Studios in Minneapolis, Minnesota, a well-equipped facility with a lot of experience doing this type of work. (They collaborated with Alias/Wavefront to develop their MotionSampler 2 capture software.) For the session, two dancers donned Flock of Birds motion capture receivers made by Ascension Technology. This hardware provides a data stream to a computer running MotionSampler, which in turn tracks the positions and movement of the dancers' bodies as they performed their avant-garde revue. When the motion data is applied to a model in PowerAnimator, it will move exactly as the dancers did.

The characters and set were created with Alias PowerAnimator 7.0. To allow sufficient control over the surface detail on the animator character's head, the mesh consists of six separate NURBS patches and four blend surfaces, which are used to connect the face sections together.

Landreth accomplished realistic mouth movement by careful study of his own face when forming sounds and a couple of books on facial anatomy. He decided that 13 key muscles provide the range of emotion and mouth movement required by the piece. By determining the effect each of these muscles has on the face, he was able to modify the control vertices (CVs) on the neutral face's NURBS surfaces to create a total of 10 morph targets.

A PowerAnimator utility called ShapeShifter was used to create a control panel with 10 sliders controlling the percentage of change from the neutral face to the 10 morph targets. ShapeShifter allowed Landreth to create complex expressions by layering the effects of morphing toward the individual morph targets. For example, if an expression of surprise was needed, he could adjust the sliders for the brow, mouth, jaw, and eyes away from the neutral setting and toward the morph target position, tweaking them until he achieved the desired effect.

Phonemes are the sound components that form spoken language, like *oo* or *f*. We adopt particular mouth shapes and movements to form each one. To form the phoneme *p*, for instance, we purse our lips and then part them while exhaling. To make the head speak, then, the lower facial muscles were manipulated with ShapeShifter to form the characteristic phoneme shapes. To achieve lip sync with the recorded dialog, the soundtrack was loaded into PowerAnimator's SoundSync module (co-developed with Windlight Studios), which allows the user to identify the exact moment a particular phoneme is being pronounced and adjust the animation to match.

A new particle system effect in PowerAnimator called CompuHair contributed significantly to the unique imagery of *the end*, adorning the characters with naturalistic flowing hair. CompuHair generates thousands of simple line-segment primitives and arranges them into a mass of hair-like strands. The hair can be controlled by forces such as movement, gravity, wind, and turbulence. These forces are adjusted by the user, and then CompuHair decides what effect they have on the individual strands of hair and moved them accordingly. While the images printed here may give you an inkling of how good the result looks, you have to see it in action to appreciate it fully.

"What do you mean, we're not real?" The characters confront the mysterious animator. Facial expressions were animated by determining the effect of flexing each of 13 facial muscles, assigning 10 morph targets, and combining morphs from a neutral face using the Alias ShapeShifter utility.

The soundtrack was composed by *the end*'s co-writer, Robin Bargar of NCSA. It employs several experimental techniques, including sound morphing, procedural sound composition, and interactive environmental sound layering.

In all, the production took about six months to complete. The hardware used ran the SGI gamut from Indy to Challenge, and much of the work was done with beta versions of PowerAnimator 7.0.

The Animator

Interestingly, Chris Landreth has no formal education in computers or art. With a background in mechanical engineering, he broke into the CG field about five years ago. While doing research at the University of Illinois, he got interested in the Renaissance Experimental Lab project at the National Center for Supercomputing Applications (NCSA) just down the street. The Renaissance Lab was the brainchild of university art instructor Donna Cox, who saw a need to bring art students and computers together. The lab had about 25 Iris computers that were available for whatever type of work the students wanted to do with them.

Eventually, Landreth became the senior animator at the North Carolina Supercomputing

The animator discusses possible endings for his piece with an associate on the phone. Just whose animation is this, anyway?

Center and was involved with several animations that made it into the Electronic Theatre, including *The Listener, Caustic Sky,* and *Data Driven: The Story of Franz K.*

About two years ago, he went to work for Alias/Wavefront as an animator in the product development department, where he helps develop, refine, and test their software from an artist's perspective. Currently, he works with both the Alias team in Toronto and the Wavefront team in Santa Barbara, California.

SOURCES

Alias Power Animator V. 7.0
Alias/Wavefront
110 Richmond St. E.
Toronto, Ontario M5C1P1
Canada
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416.362.9181
416.362.0630 FAX
info@aw.sgi.com
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Motion Capture Hardware
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Box 527
Burlington, VT 05402
802.860.6440
802.860.6439 FAX
ascension@world.std.com
Reader Service #204

The Future

Landreth views the recent mergers of Alias and Wavefront and their subsequent merger with SGI as a very positive thing.

"There's no way that, by itself, any one of these companies could have undertaken the kind of research and development we're doing now," he points out. "The results of this work will have a tremendous impact on animators in terms of freedom, productivity, and ease of use."

Another of Landreth's outlets, Project Maya, is a joint effort between SGI and Alias/Wavefront to develop the next generation of graphics software. The goal is to set new standards and develop new technologies and interface designs that will lead to dramatic increases in realism, speed of production, and creative freedom. The first results of Project Maya should make it to the marketplace in late 1996.

With the recent 3D Paint software and the CompuHair particle system allowing virtual actors to appear more realistic, I asked Landreth how long it will be before we see character animation that is indistinguishable from video. "Quite a while," he replied. "*Maybe* by the end of the century, but probably not." Since we're so well attuned to human appearance and movement, he noted, the more we try to pass off a digital actor as real, the smaller the error it takes to spoil the illusion.

The animator character realizes that he, too, is a work of fiction. The blobby hair effect was created by taking CompuHair settings to extremes.

The animator goes through several morphs as he/she wonders about his/her true nature. The face's mesh consists of six separate NURBS patches and four blend surfaces, which connect the face sections.

The End

Although he's occupied with Project Maya, this is not the end of Landreth's animation efforts. His work no doubt will be seen in a future Siggraph, where it will again make the audience gasp (and Alias/Wavefront's competition groan). Oh, by the way, those "hand-bird things" were inspired by a serious CG art piece done by Joan Staveley for a previous Siggraph. Landreth met Staveley at Windlight (where she participated in the production as the senior motion capture coordinator) and she agreed to let him take a good-natured potshot at the fluttering metaphors.

Next month, we'll get away from our dark little cubicles, glaring monitors, and coffee-stained keyboards and go *outside.* We could . . . um . . . sit in the park for a while, or go for a bike ride, maybe the zoo? Arrgh! Who am I kidding? Boot up *Wing Commander IV* and blast some Kilrathi. Too much sun is bad for you, anyway.

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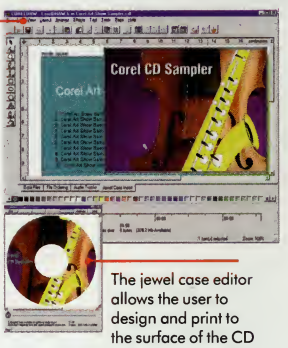

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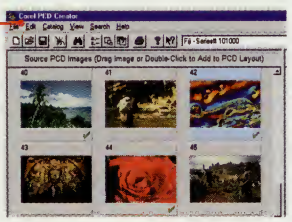

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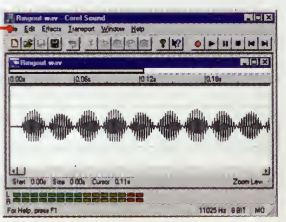

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